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FROM HOME TO THE CHARGE: A PSYCHOLOGICAL STUDY OF THE SOLDIER

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From Citizen to Soldier

The men who are fighting under the peculiar strain of modern war, exhibiting qualities apparently hitherto foreign to their nature, living in unprecedented situations and enduring hardships with great calm and utter fearlessness were a short time ago peaceful and normal citizens. To understand the transformation of character many personal narratives must be followed and close investigation made of the subtle influences which have played upon the soldier mind. Whatever conclusions are derived it is evident the soldier is created out of the citizen material, that with him he brings in some way not yet clearly defined the legacy of the phylum, the power of response to certain situations, and that according to the persistence of human experience the pre-war man must largely determine the responses made to the unusual environment of the battle-field. The evidence so far accumulated is sufficient to demonstrate that even the mental attitude assumed towards army service will often determine types of behavior under certain circumstances. A soldier is governed by his desires. If he has unwillingly renounced the past to participate in the ordeal of battle ensuing unconscious psychic conflicts play a great role in his new career. All such soldiers, whether volunteer or conscript, are tremendously influenced by repressed desires and the light thrown upon the working of the unconscious by a study of war neuroses opens up a large field for psychologists. What phylogeny and onto-

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geny contribute to soldier qualities must be considered therefore along with the response made to the immediate environmental stimuli.

So suddenly precipitated was the present conflict that the potential soldier had very little time for reflection. The nation was plunged into mental chaos. Previous to the declaration of war this was characterized by psychic tension—expectation, restlessness, anxiety and a growing depression. Responsible individuals tried to comprehend the pending national catastrophe from a personal standpoint: political considerations were intensified and the ego assumed greater importance as these were finally interpreted in the light of protection for family and of business interests. When hostilities began however, there resulted a submerging of the individual into the national consciousness, a process which was slow and never complete in the experience of many. Life was characterized by quick associations, impulsive and precipitate judgments and greatly accelerated activities. Individual thinking almost ceased, the processes of consciousness for many were stagnant and dissociated; people were governed almost entirely by their emotions. All minor political and religious differences faded, the sense of self was diminished and persons who were previously reserved and self-contained found themselvs one with thousands of others in will, acts and feelings. In this condition where there was marked contagion of affective states and imitation played an unusually important rôle people often acted with abandon and regretted their behavior in the few quieter moments of reflection. Everywhere the mob spirit gained mastery. Those who as individuals were respected and admired for mental stability and independent action were one with the crowd in thought and deed. All psychic activity was collective, strong and quick. There seemed to be a diminution of personal responsibility, of the ego's power to resist erstwhile repugnant and antipathetic suggestion. Consequently unnecessary food panics resulted and the least item of bad news assumed alarming proportions. In such a state of unbalanced mental equilibrium communities reacted all out of proportion to the nature of the stimuli, and some collapsed under the pressure of the feverish activity. Owing to business panics men were forced into unemployment or else were requested to enlist immediately if they desired to retain their position in the post-war period. Whole cities faced new problems through the influx of soldiery and the commmandeering of equipment necessary for government purposes. In a few days the tra-

ditional, habitual modes of living experienced a metamorphosis bordering upon the miraculous so that people lived in an unreal world, often of overwrought fancy.

Great credulity was characteristic of the peoples of all the warring nations. Thus in Germany stories of the capture of the Russian fleet in the Kiel Canal were believed and one author, (W. D. Kurt), tells of a persistent rumor that a yellow French auto with 400 millions in gold was somewhere on its way through Germany to Russia and all kinds of precautions were taken. Bridges were barred and watchmen were posted. A driver of a large yellow auto was shot, apparently by the police, and many others were held up by officials and mobs. In one case even a Prussian officer on a suspicious auto was fired upon despite his vigorous protest. Rumors often reached the newspapers of the approach of a vehicle of this kind. In England we were constantly informed of the landing of Russian troops on the east coast of Scotland and that they were continually passing along the east coast on their way to France. Many persons vowed they had seen them even in the terminal station of Liverpool although as we now know such accounts were pure fiction. So complete was the mental instability that any story was immediately believed if it revived or bolstered the lagging and dejected spirits. The constant fear of danger to one's person and nation created psychic states voracious for fanciful phenomena.

In addition to the preceding factors the potential soldier was influenced by a more subtle suggestion. He saw the military uniform everywhere. In the parks he watched hundreds of young men drilling; men who had immediately enlisted. Their untidy appearance and awkward movements at first amused him, but soon, as the men under competent leaders gained poise and military smartness, his contempt turned to respect. Invariably he experienced strange emotions followed by the decision "I must enlist." If he approached a recruiting station the long lines of young men eagerly and patiently waiting to join mysteriously attracted him. Many have declared "The mob spirit gained mastery over me." An important suggestive factor was the advertising posters. Wherever the citizen turned he was confronted by them. They were appealing. He was hypnotized by their personal application. He was needed; upon him depended the safety of his country and his home. At one moment his social instinct surged into consciousness, another that for self-preservation. Furthermore these posters created group attitudes until everyone thought in the mode they sug-

gested. They became topics of conversation with a moral of no uncertain sound, and thousands responded at their suggestion. While the picture was the most appealing factor of these posters, the short, pointed sentence, printed in appropriate ink, seldom failed to occupy the attention for hours and days. As an illustration of these we have the following:

1. "England Expects Every Man to do His Duty"
and
Join the Army
To-day.

2. "Join the brave throng that goes marching along." (with picture of soldiers marching).

3. Surely you will fight for your King (picture of) and Country (picture of). Come along boys before it is too late.

4. Why Aren't
You
in Khaki?
You'll be wanted.
Enlist at once.

5. Thousands
Have Answered
The Nation's Call,
But You May Be
The One
To turn the scale
at a critical moment.

Do you realize this?

Consequently from the factory, work-shop, store, farm, office and college, men flocked to the colors. They had been motivated to respond by many forces which may be summarized as: the emotions of fear, anger, and the instinct of self-preservation; love of adventure; social pressure including family tradition; economic pressure; the desire to win the praise of friends and of the community, and the sense of the heroic. Undoubtedly for some the army offered a path of least resistance, a means of security with approval, so uncertain had personal matters become. Of this heterogeneous army Von Hindenburg said, "Even if there were a million, they would form no real army, but a uniformed crowd." He did not estimate the fundamental nature of the

human organism and its power of adaptability when activated by the instinct of self-preservation, nor did he consider the moulding force of a directed purposeful environment.

The army is a leveller of social groups. In the ranks common dangers, sharing of difficulties, eating, sleeping and working together, wearing similar uniforms and being subject to the same rigid rules, weaves around the men a cloak of brotherhood and breaks down individual distinctions. Between men and officers however there remains a social distinction. It appears necessary to enforce discipline. Men will more readily obey those whom they are accustomed to recognize as socially superior, who have "blue blood" in their veins. Even older men readily obey the commands and trust themselves to younger officers provided they possess the mark of social superiority. When once the average soldier dons the uniform his individuality begins to submerge, to dwarf into nothingness and to find a new life in the group consciousness. One man said, "We had lost our individuality, and it was to be months before we regained it in a new aspect, a collective individuality of which we became increasingly proud." (27, p. 9.)

Personal liberty becomes a thing of the past; the new society and the state assume paramount importance. With this transition there comes peace, mental poise and relaxation. Previously the emotions had been at a high tension, men felt as if they would 'burst' as they were torn asunder by impulses and desires. Now with the loss of responsibility they can rest with abandon, cease to think about old problems and find psychic and physical relief in the simplicity of their surroundings.

The rapidity of adaptation is determined by the mental constitution of the individual and the motive which prompted his enlisting. If he unreservedly entered the army, or has reconciled personal and state obligations, he will soon fit in; but if not, if he has been coerced into army life, his actions will be marked by sullen independence and unsocial behavior, while probably some mental complex will be built up to buttress his desires and to obtain release from actual fighting.

Necessarily the change is slow. After six months training in Canada and England a college friend wrote, "It seems strange not to be able to arrange one's own plans but to merely obey and to shut up," and another soldier put it, "At the beginning they were individuals, no more cohesive than so many grains of wet sand. After nine months of training they acted as a unit, obeying orders with that instinctive

promptness of action which is so essential on the field of battle when men think scarcely at all." (27, p. 32.)

No environmental change could be more radical. New forces impinge upon the mind and create a different mental attitude. Everywhere things move with precision, organization makes life mechanistic, and the details of the present control the attention and blur the memory of the past. Initiative and freedom of thought are no longer possible. Both are dangerous. The men must obey. Consequently discipline is all-important and to secure the psychic state conducive to child-like obedience and unquestioning performance of commands, and at the same time to keep the respect of the men, is the most difficult task of the officer.

"Half the work of their instructors consists in getting them into the proper frame of mind and giving them that esprit de corps which is essential to the war fitness of a volunteer army." (67, p. 11.)

At first the men are surly and obey unwillingly. They find fault with details yet accept hardships cheerily. The details appear as impositions seemingly unnecessary from their point of view of war. Gradually they realize the futility of kicking against the pricks and learn they belong entirely to the government. Only the officers are allowed to think upon the affairs of the regiment. It is a dogma that they alone possess common sense.

"To safeguard this dogma from ridicule it is necessary that the men should be prevented from thinking. Their attention is to be fully occupied with such mechanical operations as the polishing of their buttons in order that the officer may think without fear of contradiction." (28, p. 31.)

and

"Cleaning greasy pots, scrubbing floors and drilling produced no thrills. They simply bored us. Life was dull and prosaic, and, as we have said, uncomfortable. No one ever said anything interesting. We never got a chance to sit down and think things out." (28, p. 107.)

It should be noted that the author of the preceding quotations represents an extreme type of individual. Being a university graduate he naturally finds army life dull and prosaic, yet he is better equipped to pass judgment upon the mental lethargy so common to the soldier experience.

In the training camp, hundreds of miles away from the war zone where life is simple and strict, the finer sensibilities are clouded, the mind assumes little importance and the body occupies the prominent place. Men live in the realm of the physical; the psychic activities are reduced to the lowest level. There is no mental stimulation, intellectual compan-

ionship is rare, the attention is focussed upon the immediate surroundings and conversation is concerned with the trivialities common to the camp. Every man thinks about the same subjects, which are seldom philosophical, religious, emotional or problematical; there is lack of criticism, but great docility and naïveté so that the mind becomes simple, shallow and childish. Very seldom do they talk about the trend of the war, yet they look forward eagerly to their advent into the war zone. Gradually images of the civil life fade and only in a limited manner do they think of home and friends. Their quarrels are usually over the possession of pleasure-supplying commodities; they never suffer mentally, only physically. Some men are exceptions owing to their previous mental training but by far the majority live entirely in the realm of sense impressions.

For the most part the soldiers who are in the ranks represent a society unaccustomed to specific intellectual pursuits; they have been accustomed to obey their superiors in other careers and consequently the surrendering of individuality is not difficult and is, in fact, compensated by the pleasures and physical activities of the group. There ensues however for a smaller company of men of intellectual attainment a mental conflict in which the love of individual liberty and self assertion, long enjoyed and cherished, revolts against military despotism. Owing to the rigorous discipline and the absence of mental stimulation, to the sense of isolation, these men are forced to repress their wishes and to philosophically accept the fate of their environment. Some yield to the regressive tendencies and with the majority find pleasure on the lower phyletic levels, but others retain their former poise and personality, they have a strong imagination or as one has aptly expressed, a sense of the dramatic. They obey and execute commands immediately and often become leaders of companies but they are never really one with the crowd in thinking and behavior. Representative of this group are business men and students. One of these says:

"It is a faculty which gives zest to life: putting boredom and oppression to flight, stimulating humor, humility and idealism." (28, p. 182.)

Few, however, can sublimate their wishes and turn their energy into imaginative and constructive channels. The majority revert to animal levels, are the slaves of impulse and desire and are governed almost solely by the pleasure-pain principle. Much of their spare time is spent telling obscene stories and in jesting about sexual matters.

A soldier's training aims to give a consciousness of physical fitness. Nothing is more important than a sound body, well coördinated, supple, healthy and strong. It increases self-confidence, gives self-control, creates morale and prepares the nervous system for the more strenuous work of actual fighting. Also certain types of behavior must be established, the mind accustomed to resist shock and a peculiar emotional experience evoked, similar to the excitement of the charge. All activities are planned to elevate the physical and to put the intellectual life in abeyance. From reveille until "lights out," the red blood is kept pounding through their veins. At daybreak the men are awake and for one hour before breakfast go through Swedish drill. As they progress in the execution of duties, leaving behind squad, platoon and company drill, the more important work of field manoeuvers constitute part of the program. Twice a week the battalion marches from ten to fifteen miles. For months several hours daily are devoted to musket and bayonet practice. During the latter the men charge over fields and into the trenches to thrust the blade into dummy figures. Trenches are constructed, instruction is given in bombing, sniping and the use of machine guns, in fact, every condition of the war zone is imitated as much as possible. Special training is afforded according to the division and type of service, and all is characterized by earnest, eager endeavor to do the task thoroughly and creditably for the honor of the battalion. Occasionally mimic battles take place in which between ten and twenty thousand men on each side oppose each other. Artillery, infantry, cavalry, field ambulance, air craft, in fact, every branch of army service engage and share in victory or defeat. In all practice of attack in open formation upon intrenched positions the men finish with terrific bayonet charges shouting lustily as they proceed.

After the duties of the day are over the soldiers engage in boxing, wrestling and athletic contests. The spirit of rivalry, of attack and defense is fostered whenever possible. Companies compete with one another in all branches of athletics: the soldier is a sportsman. In many ways the physical energy finds expression. There is continual horseplay, much practical joking, very often fist fighting, and withal much pleasantry, and an abundance of fun. Various organizations, foremost of which is the Y. M. C. A., provide entertainments and social games, by far the most popular being those in which the men can participate either by singing or performing. As a rule all are physically tired when 'lights

out' is sounded at nine o'clock; they are contented and feel as never before radiantly, buoyantly healthy.

When the necessary adjustments are made to the new conditions of the camp, life does not appear monotonous and dull. Time passes very rapidly and many prefer the varied program to the old forms of labor in the workshop, factory, on the farm, or at the office desk. Great pleasure, exhilaration and satisfaction are derived from the war game. On the march the rhythmical swinging step, martial music, admiration of the onlookers and the glamor of the uniform evoke a consciousness of strength, increase the feelings of contentment, elation and pride and simultaneously help to subordinate the ego to the welfare of the battalion. Participation in manoeuvers mechanizes the mind, develops the power of self-control, enforces discipline, curbs curiosity, suppresses fear and eliminates the use of initiative unless the soldier is a part of a special squad assigned to such practices as bombing, sniping and scouting. Fatigue duties, caring for the camp and attending to the many details of military life submerges individuality, narrows the mental vision, fosters patience, discipline, and respect for their officers. After months of training the men grow tired of the war game and become restless, eager and desirous to go abroad.

A natural question is: By what method are the men located in the specific branches of the army service? How are mental traits and physical aptitudes correlated with the new sphere of activities?

To such questions we can only answer we do not know. That some process of analysis takes place is certain but the actual procedure is a government secret. Some French morphologists (10) have suggested that their government bases the assignments upon the type characteristics. These types are conditioned by rapport with the environment, cosmic elements, air, earth, and water. The examinations consist of measurements of the head, the trunk and the limbs. Four types are suggested: the muscular; digestive; respiratory and the cerebral, but more often combinations of these exist. As a result of continued struggle against the environment we have the muscular type. He is characterized by a rectangular shaped face, and strong, regular, well proportioned limbs. This type constitutes 47% of the French people and is found in the agricultural districts. As a soldier he is best in attack, or if muscular-digestive he makes a good artilleryman. The digestive type has a truncated-pyramidal shaped head, a large digestive apparatus, the trunk is long, the limbs short,

round and fat, and the thorax is small. He depends upon good alimentation for his well being. As a soldier he is best in defense. The third type, respiratory, supposedly a descendant of nomadic tribes, has a large thorax and the face is hexagonal shaped. Respiratory individuals are best fitted for service in outposts, in high altitudes including aeronautics; they make good sentinels and cavalrymen. Finally, the cerebral, smaller in figure, with a face shaped the reverse of the digestive and often brachycephalic, supplied before the war only 7% of the number of soldiers. This type suffers least from hardship at the time, keeps up in forced marches, and makes good officers and secretaries. The disposition to disease of these divisions may be generalized as (1) catarrh and asthma; (2) disease of the alimentary apparatus; (3) rheumatism; and (4) headaches. Naturally pure types are rare but usually there is a predominance of one over another. Probably such a system has been adopted by the French and applied in the selection of men during the present conflict and that most of the larger nations have made a selection based upon certain mental and physical dispositions is an established fact.

To this interesting problem the camp life of the soldier lends some suggestions. In connection with every site there are numerous things requiring care and attention. Miniature cities are erected in a few days and when completed they need repairing. So we find men are assigned duties which approximate their vocations. The laborers dig roads and install drainage systems, joiners erect huts and attend to all wooden structures, electricians contribute their experience, clerks are busy at headquarters sorting mail and assisting with the tremendous business of accounting and provisioning, cooks and bakers find their trade always needful and in many ways we see vocational selection. It does not stop here however. The miner becomes a sapper, the mechanic, usually of strong physique and quick mind, mans the artillery or becomes a machine gunner, the engineer builds bridges and cares for the unlimited mechanical appliances used in modern war, and the young business man is always useful in the headquarters division where brains and clerical capacities are required. Vocational selection provides men for special branches of service. It insures not only the necessary psychic qualities but the facility of execution which can only come from long acquaintance in the particular field. For still more specialized work such as the air service recourse must be taken to the finer type distinctions previously suggested.

One value of specialization is often overlooked. Not only does it guarantee organization and efficiency, but these in turn become forces moulding the soldier mind, fostering precision of movement, discipline, love of accuracy, and sociality. It produces the spirit of the hive. All are workers, the men perform their duties with zest and effort and obtain fun and pleasure from them. The exceptions to this are found amongst thinking individuals who are only bored by the monotonous repetition of manual labor. Withal the soldier endures hardships with serenity, patience and determination, grumbles at trifles, yet is ever alert to express his abundance of humor, gaiety and jocularity. When he leaves camp for the fighting front he has a strong physique, nerves of steel, a mind trained to obey and to coöperate, and inured to the dreariness of repetitive action and capable of finding relaxation in the meanest environment.

In this transitional period the tremendous moulding force of epigenetic factors is demonstrated. Everywhere the mind is impressed and altered by them. Other forces are also at work. The real self of the men, the unconscious, also motivates and directs them. It is not so much repressed by traditions and customs. Everywhere the sexual desires find expression resulting in a regression to the lower phyletic levels where coarseness and vulgarity vie with animalism. Perhaps this is due in part to the concentration of large numbers of men, who in society passed unnoticed in the performance of sexual perversions, but, now finding the restrictions removed, and lacking almost entirely the elevating moral influences of family and social life, are governed by this instinct, are controlled by powerful desire. The unconscious, the product of phylogeny and ontogeny finds in a soldier's environment outlets for long repressed wishes and thus reversionary forms of activity are manifested. On the other hand the love of life, and the impending fear of death build up mental complexes and effect changes which lie hidden until a crisis is reached. Later, in section four, we must view these from another aspect of soldier psychology, namely, the war neuroses. At the present, indications point to both epigenetic and endopsychic factors coöperating in producing the soldier out of citizen materials.

The Soldier in War

There is little to be written about the departure from the training camps, probably because the time has not arrived for men to recall such an apparently unimportant phase of war,

but when the period comes for reflection we shall undoubtedly learn more of the psychic states typical of what is really a momentous event. We know however a few details of this period. There are no parting scenes, no farewells; these have all been enacted weeks before upon the occasion of the last furlough. The men entrain for an unknown seaport and a still more remote destination. Only the cheers of comrades awaiting the next transport greet the men for all civilians are held in the rear of the quays. The business of war is early impressed upon the soldier mind, and as a business undesirable and to be quickly finished he will always regard it.

Although the few accounts we have of the journey from England to France all emphasize the cheeriness, jocularity and good humor of the men, there is little doubt that the experience of the soldiers is totally at variance with their apparent indifference to hardships. The surface hilarity may exemplify ambivalence, or it may result from a conscious effort to repress the expression of discontent and to banish the feelings of uncertainty which arise during this period of transition. On the troopship they are huddled together, obliged to sleep on the sawdust covered floor or on the side benches, while many are sea-sick and unable to rest. For the most part they do not betray their feelings by grumbling and complaining, rather they give the impression of contentedness as they sing songs, engage in banter, and congregate in groups puffing at their cigarettes and pipes. It is essential however that we notice the real mental attitude beneath a feigned conduct, for soldiers are human; they appreciate comfort although they do not anticipate much of it and often their good humor is simply a way of making the best of a bad job. Their conduct does not betray despondency; to many the occasion marks their first voyage or sight of the sea, they are filled with wonder and often delighted, but as an undercurrent to the surface thoughts, welling into consciousness in reflective moments, forceful and commanding, are the memories of home, and the homeland, combined with the imaginations of the unknown and long anticipated entrance into war. Of these reflections they seldom speak so that one notices only the customary cheerfulness which has been recognized as a soldier characteristic. Upon arrival at the port, they proceed to camp, a city of bell tents, where they procure equipment and rest for the night. Here men invalided from the firing line relate stories of battle and often leave the impression that it is one great adventure. Early the next morning they fill the long lines of troop trains which are usually composed of

trucks, very uninviting, uncomfortable and not conducive to evoke good feelings or pleasantry. The men undoubtedly endeavor to accept stoically these conditions and in this they are aided by the novelty of a new country, but lest any should confuse the happiness born of an advantageous adjustment to one's environment with the good humor and gaiety of the soldiers, evoked to soften the hardships of their experience, it is only necessary to point to the accounts of discontent often hidden beneath the rhetorical skill of an author. In a personal letter written immediately upon arrival "behind the lines" the case seems to be clearly defined:

"We were five days on our journey which was comprised of a combination of experiences I am not anxious by any means to encounter again, but still if they come—they come, and the best thing is to get through them as cheerfully as possible, which is perhaps not as cheerful, at times, as optimists in songs depict. We had a railway journey of twenty-eight hours, which was the most unique and luxurious I have ever had—a real joy ride. (I don't think). However we prepare for other things instead of a 'feather bed' existence and there are thousands much worse off than we are." (Written March, 1917.)

The cantonments, in which further training is given, vary in character according to their location and size. Invariably they are within sound of the guns where the men may accustom themselves to the minor conditions of the war zone. Usually they present a highly socialized community much like the early training camps. The discipline is now severe. Offences previously considered trivial are crimes punishable by confinement in the guard room. In place of practice in trench duties and longer periods of rest more rigorous tasks are enforced. There are endless parades and the customary practice of Swedish Drills, bomb throwing and bayonet fighting. According to one writer (27, p. 133) the men charged at dummy figures clad in the uniforms of German foot soldiers. If we apply the typical conditions of their early training to the cantonment and remember the dominating influence of the physical life, the narrowing of the psyche, the absolute dependence upon officers, the rigorous discipline, and the abundance of fun and horse-play, we can consider briefly some new factors which play upon the soldier mind.

The new arrivals are much impressed by the indifference to the actual struggle. Men who have been in the trenches seldom talk spontaneously about it, in fact, were it not for the boom of the guns and the incessant movement of troops one might suppose no war was proceeding. "Everything around here, except for the sound of the guns, appears so peaceful that one cannot imagine anything serious going on

about three or four miles away." This seems a typical attitude of the British soldier. Even before the present conditions of trench warfare, which might repress the desire to relate experiences, reticence regarding combat was very noticeable. As an illustration the words of one who lived close to the battlefield may be cited:

> "It suddenly occurred to me, as we chatted and laughed, that all the time the English were here they had never once talked battles. Not one of the Tommies had mentioned the fighting. We had talked of home, of the girls they had left behind them, of the French children whom the English loved, of the country, its customs, its people, their courage and kindness, but not one had told me a battle story of any kind, and I had not once thought of opening the subject." (1, p. 167)

War is a business to be seriously left alone when the fighting hours are over. However, everywhere the men refer to personal safety and among the majority a passing remark embodies the wish for a "Blighty" wound which is a wound slight in character necessitating removal to a hospital in England. Another factor which the cantonment presents is the absolute confidence and calm of the men who have spent months in the trenches. They have tested the enemy's strength, repelled his attacks, experienced and survived many dangers and through all have developed qualities which cast out fear, so that what they have once accomplished they feel they can do again. A comparison of the members of an old with a new battalion while on parade previously to entering the trenches reveals the former as resolute, firm, composed and confident in their own strength, while the latter are restless, uneasy, tremulous and fearful. These three factors, indifference to war, the continual reference to "Blighty" wounds as insignificant and desirable, and the self-confidence of the veteran. are potent influences which greatly decrease the nervous tension, allay many fears and rid the battle-field of much of its terror for the recruits; although only actual experience produces the attitude which typifies the accustomed fighter. In addition to these may be considered the example of the peasants who are often under fire and are indifferent to it.

To return to the billet for a further glimpse of the activities we may say that life is varied, often severe and difficult, yet sometimes conducive to merriment and fun, when games are played, and theatricals, concerts and various forms of entertainments are organized in which the soldiers play the important rôle. The old form of story-telling has been superseded by the literary and humorous productions of mem-

bers of the battalions. Carrington has given an interesting account of some of these papers. He says:

> "The French particularly have excelled in this. For example, they have issued a periodical in the Champagne, entitled Le Poilu, which defines itself as "A journal, humorous, literary, and artistic, of the life of the troglodytes; to appear when and where it can." It contains impressions of the war, messages from home, news and bulletins, Rabelaisian sonnets and other material. Another entitled La Gazette des Tranchées (issued in the Argonne), 'an organ founded to maintain the spirit of mirth in France' gives scraps of Parisian life, of the Boulevards, etc., in the character of a general 'Revue'." (9, pp. 54-55)

In contrast with the lighter vein there are the periods of religious observances, church parades and tent meetings, but a consideration of the soldier's religious attitude must be deferred until later.

Undoubtedly many other features not enumerated prepare the men for the actual combat. All the soldiers do not experience the intense coöperative life in the cantonment but live in old buildings, barns, or with the peasants. They do nevertheless participate in all other regimental observances, meet tested and hardened warriors, become acquainted with the boom of the guns, the sight of mud-covered comrades and in general pass through a stage of psychic degeneration, at least of the finer sensibilities, while confidence is gained to enter upon the older racial types of behavior which characterize trench warfare.

The first experience in the trenches is designed to introduce the new regiments to their task. They spend only twenty-four hours in them upon this occasion and are usually situated between well trained troops. The period has been named the "Parapet-etic School." As they move forward, experienced fighters, cognizant of the fear which possesses these students in warfare, never miss a chance to express jokes such as to casually inform them they "have been fattened for the slaughter," and "the communicating trench leads to the cemetery." Typical of soldier discipline incoming troops always give the right of way to the tired outgoing regiment. New troops are always reckless, eager to see the enemy, are slaves of uncurbed curiosity, and only learn at the cost of lives to keep beneath the parapet. The sentinels imagine foes lurking on "No man's land" and at the least disturbance the whole company will man the loopholes and fire recklessly into space. The slightly wounded relate their experience; everyone is intensely excited; and the officers are anxious, grave and worried lest their men should fail. When relieved all feel they have repelled attacks and deserve praise

for their conduct. The older soldiers say the newcomers use more ammunition and material in one day than they would in a month.

One of the first impressions upon entering the trenches is of the tremendous noise and incessant movement. There is little calm, or rest, for the brain. Artillerymen, machine gunners, snipers, sappers, airmen, all vie with each other to secure the coveted advantage called "morale." At first the mind is continually excited and overwrought.

"It must be true of this war (I hear the same thing on all hands) that what strikes you most about it is its overwhelming noise. All the other sensations are secondary—heat, cold, pain, fatigue, danger. That's Nature all over. She doesn't allow you to experience more than one emotion at a time. I know that the four days I've just spent in the trenches have left this one impression on my mind: a shattering roar which no language can describe." (71, p. 39)

Eventually the human organism adjusts itself to this ordeal, for the soldiers take pleasure in counting the shells, judging their size, following their courses and guessing where they will fall. According to their size and speed they have been given special names, such as "Coal Boxes," "Whistling Willies," "Jack Johnsons," or "Black Marias."

For days the walls of the trench, the sandbags, the inside of their dugouts and an occasional glimpse through a loophole or periscope at the German parapet, perhaps a hundred yards beyond, constitutes the visual range. Some men have been fighting an enemy for months without ever seeing him. Under these conditions there is a complete narrowing of the psychic life. The physical sensuous nature almost entirely rules. Constant exposure to danger, the focussing of attention upon the means of defense and self-preservation, the uncertainty of physical safety, lessens interest in the details of the day and produces almost a strange hypnotic state of mind in which physical utilities assume supreme importance. As a natural sequence food is very essential for the maintenance of combative efficiency. It has been said "The soldier before dinner and the soldier after dinner are two entirely different beings." The hungry ill-fed soldier cannot fight, he will grumble, lose confidence and often revolt, but given abundant food, with his tobacco and rum, he is an animal, ferocious in the fight and indifferent to the things of the intellect. Referring to such pleasures of sensory appreciations Sir Bampfylde Fuller writes:

"He (man) has so elaborated the simple enjoyment of eating and drinking that for many persons it becomes life's chief attraction; they live to eat; and it is interesting to observe how this pleasure dominates

all other interests when men relapse into the savagery of war. To the soldier in the trenches his meals become the pivot on which the day turns; an army must be well fed in order to respond cheerfully to the general's orders, unless, indeed, the men are fired by religious or patriotic ideals into a glow of self-sacrificing fervour. In conditions of long drawn war, men's tastes revert to the simplest forms and (as letters from the front have amply testified) the greatest hardships may be alleviated by presents of cakes and sweetmeats." (21, p. 139)

In times of intense fighting when for days it is impossible to procure rations the dead are stripped of their packs and one writer (45) reports a case where food covered with blood has been ravenously devoured. The latter should be taken with reserve. Every indication points to a reversion to primitive types, to lower racial levels where the needs of the organism are supplied no matter what the cost. When regiments are seated around the tables in billets after a battle, they notice the gaps in their ranks, and in a dim, almost unconscious way realize in some home there will be a measure of desolation, yet these gaps are taken as a part of war; by the laws of chance they themselves still eat and drink and can be merry. In the act of eating the pangs of sorrow entirely disappear. Food is theirs; why worry about what happened a few days ago. So it is that losses are not felt keenly.

On the firing line, the nearness of danger and possibly of death, although the soldier never believes he will be killed but by some miracle will receive merely a slight wound, automatically breaks down most of the individuality that might be left, throws the men more completely upon the resourcefulness of their officers, more closely unifies and welds the group together and insures complete obedience to authority. Men and officers are inseparably united by the common bond of danger, while their proximity reciprocally dispels the pangs of fear and uncertainty. The massing together of men governed by the instinct of self-preservation, intent upon the destruction of an enemy and performing onerous duties as effectively as possible, releases hidden forces of resourcefulness, endurance, and strength which are directed so as to protect not merely the individual but the group. All are bound together in a common cause; class distinction, social superiority, is forgotten among privates and even the officers are not regarded primarily as a socially privileged class but are superior because they possess authority, valuable information and are invested with the right to think and decide matters of extreme importance. Instinctively the need of a leader is felt; it is a soldier trait to imitate and this satisfac-

tion he obtains through his officers. Without leadership he knows the company would be a mob, ungovernable, and more dangerous than his greatest enemy. Fortunately the officers are usually men possessing most of the soldier virtues, who exemplify the valor, bravery, courage and recklessness necessary for aggressive warfare while excelling also in the important qualities of patience, determination, sociality, discretion and strong sympathy, so essential during the trying months of trench confinement. The graphic words of one of these men reveals a chapter of social psychology: "It's hard marching, shrapnel and machine gun fire, barbed wire and all the rest of it that levels cabbages and kings." (71, p. 28.)

Never before in army life has there been established between officers and men relations so cordial, often amounting to devotion to each other despite the very apparent differences of education and social advantages. Cases are by no means rare of supreme sacrifices, made, either to save their officer, or by an officer to protect his men. An officer writes:

"I've seen them wounded and keeping on as if nothing had happened. It's not that they don't feel the pain—make no mistake about that—they won't feel it. During an advance, if cover's scanty, they won't monopolize it if an officer is anywhere about. When you do the smallest thing for their comfort or convenience they're quick to appreciate it; in success their enthusiasm is the most sanely delightful thing conceivable; a reverse doesn't dishearten them. They grumble at trifles and laugh at difficulties. Oh! Tommy's a wonderful chap . . . . There's something about him, dirty or clean, swearing or silent, glad or sad, hurt or whole, that is just unbeatable. You can't knock him out. If our fellows are devoted to us it's only a case of reciprocation." (71, p. 53.)

Like gregarious animals whose strength increases in direct proportion to the solidarity of the group and whose fear vanishes with the feeling of unity so men in battle who live in a manner typical of the lower racial levels automatically seek the protection of comrades by sinking their personality into the fighting unit.

Balck. "In the danger zone which suddenly surrounds and startles him in war, the soldier feels in the first place, a desire to have someone assure him that the seemingly critical situation in which he finds himself is as it should be. His eye is naturally directed upon his officers. If the officer's quiet glance reminds him that here, as in peace time, the first duty is obedience, and if he subsequently sees the officer advance fearlessly and vigorously he will as a rule not worry about the why or the wherefore." (18, p. 33.)

Obviously dependence upon officers and fellowmen and the general condition of trench life fulfils most of the requirements of normal suggestibility. As a gregarious animal the soldier acts upon whatever is suggested to him. The

moment he enters the firing line he encounters an environment which fixates his attention upon one subject,—to kill his enemy and to preserve himself; his mind is distracted from all else and after the novelty of the first few days wears off, the monotony of his confined life narrows his mental vision and also limits voluntary movement. Thus tremendous psychic tension results; the strain of watching and seeing nothing becomes almost unbearable, and the continual emotions of fear which at first possesses all as a result of unseen foes combine to lower the reaction threshold to suggestion. The result of this is twofold. It magnifies the importance of the officers, giving to them prestige, and it merges the individual still further into the social consciousness, making discipline the handmaiden of self-preservation, and initiative its enemy.

Unless the soldiers became indifferent to the noise, to unceasing movement, to the squalid, muddy, narrow trenches, to cold, rain, heat, pain, and even death, life would be intolerable, impossible after the first few weeks' experience. It is an inherent quality of the human species to rapidly adapt the organism to its environment, and such an adaptation occurs. In order to more readily understand what is now recognized as almost absolute indifference to trench warfare, and to appreciate the genuine cheerfulness and happiness of the combatant in face of death and amidst scenes which would be gruesome, repulsive and detrimental to the strongest nerved civilian, it is necessary to determine the relative importance of fear, and also the soldier's attitude to death itself. Very often the statement has been made that the seasoned soldier does not experience fear, at least not in the front line trenches. This is only a half truth. The veteran both experiences fear and more readily confesses it than those less habituated to war, but he has gradually grown accustomed to the common dangers. For weeks the men suffer from intense fright as comrades are killed or horribly mutilated, and it is only gradually they overcome their fears and grow callous, indifferent, fatalistic—almost unmoved by the cries of wounded and the loss of friends. Fear, the primary emotion, is characterized by an ambivalent tendency. The typical forms of behavior which are its accompaniments may pass over into valor and courage, and the individual may radiate hope and cheerfulness. "Familiarity breeds contempt" or what is perhaps more true is that the human organism adapts itself to every situation, provided sufficient time elapses between the first stages of fright, and fear of the unseen and unpre-

ventable, and the secondary periods of familiarity with danger. It is not that the soldier does not fear but he has ceased to fear certain situations because he has been safe comparatively during his experiences, or he has escaped injury so often. Death is the negation of all his desires and he fears it except when he is activated solely by his emotions, then life or death do not seem to be in his keeping. The constant hope for a "Blighty" wound is born of a fear of death and so real is this fear that it creates compensating psychic states which culminate in a belief that he will not be killed. Under unique situations, such as separation from comrades, holding the advanced trenches, or when confronted by new enemy devices, fear possesses the soldier. When surrounded by companions it moves him to find protection in the group consciousness, to submerge his personality, to automatically obey and even to welcome severe discipline. His fear for personal safety is repressed; to express it while in the danger zone would incur the penalty he desires to avoid. So men fear personally yet never communicate it until out of danger. We need therefore to distinguish between the periods of intense emotion and accustomed situations on the one hand and the period of self-consciousness and introspective analysis. Soldiers who have passed fearlessly through an enemy barrage and succeeded in attaining their objective, when suddenly aware they are isolated or alone invariably experience fear, though it may be momentary. Most accounts agree that the fear of death for the soldier is not as terrifying as it is for the civilian. Their intimate acquaintance with it destroys much of its terror but the soldier actually struggling with an enemy and the self-conscious soldier are two different beings. The opinions of a man behind the lines and one just fresh from the conflict often vary and the same soldier finds it difficult to analyze his feelings without contradiction upon the same occasion.

Perhaps a few quotations may help to clarify a difficult problem. In the early stages of the war an officer wrote:

"Pain must be a relative thing, or some people wouldn't stand it better than others . . . . It can't be the colour of blood that's so upsetting; . . . . it must be because it's wet. Pity we can't bleed something dry . . . . Of course to be at war and not get accustomed to the sight of blood is an impossibility. You get callous of it when you see men laughing though they're covered with it, fighting though they can't see for it, dying for the loss of it."

"And just as you get to think of blood as a customary sight, so you become accustomed to the idea of death. It's all around you, not remote as in times of peace. It's peace that makes the love of life so falsely precious. In place where a man carries his life in his hands,

and in war, he sees death in its right perspective, which means, oddly enough, that it's shorn of its terrors. Perhaps it needed a great war like this to bring things into focus again." (71, pp. 15-16.)

From this we might conclude fear was entirely lacking, but why is blood "upsetting?" Why the pity of its very nature? The same man in a later letter commenting upon the bravery of his men remarks:

"Bravery, when you come to think of it, is one of the most fluid qualities. There is such a thin line dividing it from cowardice, and the name of that line, which sometimes is stretched so tightly that it has to snap, is not, remark you, lack of courage, but of nerves. If a man's nerves are good he stands a good chance of doing something decent; if they're not, all the more honor to him if he stands at all and does not run away." (71, p. 130.)

In this brief discussion, the factors inherited and acquired which increase nervous resistance to adverse and destructive stimuli cannot be enumerated, but is it not evident that bravery and courage are not evoked by compatible emotions but are the end results of fears, contravalent results which are uncertain, bordering upon flight or resistance? President Hall in his study of fear records:

"Yet fear has its fascinations, and strong, adventurous souls not only face danger when it comes, but go forth to meet it. Cowardice thus has its countervalent impulse in courage. The prospect of pain acts as a tonic and one does not need to be a hero to love to take risks and to venture in order to have. Not only is one measure of values the dangers we will face to attain them, but curiosity, lust for knowledge, wealth, power, ambition, control if they do not cast out fear. The great culture heroes set men free from fears. Without known danger life would be tame, insipid, asthenic. Men fight best if rightly afraid and even weak animals which would fly when brought to bay fight with the energy of desperation." (26, p. 153.)

To anticipate a study of behavior during the charge, several accounts may be used here with value. Reflecting upon the moment of advancing one says:

"There on the open field of death my life was out of my keeping, but the sensation of fear never entered my being. There was so much simplicity and so little effort in what I had done, in doing what eight hundred comrades had done, that I felt I could carry the work before me with as much credit as my code of self respect required." (45, p. 72.)

Of the same experience when engaged in ambulance work he continues:

"The harrowing sight was repellent, antagonistic to my mind. The tortured things lying at my feet were symbols of insecurity, ominous reminders of danger from which no discretion could save a man. My soul was barren of pity; fear went down into the innermost parts of me, fear for myself. The dead and dying lay all around me; I felt a vague obligation to the latter; they must be carried out." (45, p. 77.)

Of an occasion during a retreat in the same battle which lasted for days he says:

"I had got beyond that mean where the soul of a man swings like a pendulum from fear to indifference, and from indifference to fear. In danger I am never indifferent, but I find that I can readily adapt myself to the moods and tempers of my environment. But all men have some restraining influence to help them in hours of trial, some principle or some illusion. Duty, patriotism, vanity and dreams come to the help of the men in the trenches, all illusions probably, ephemeral and fleeting, but for a man who is as ephemeral and fleeting as his illusions are, he can lay his back against them and defy death and the terrors of the world. But let him for a moment stand naked and look at the staring reality of the terrors that engirt him and he becomes a raving lunatic." (45, p. 161)

Another soldier says that when leaving the trenches fear is greatest.

"The fear of being hit by shell or bullet was a hundred-fold greater than it had been during their part in action, when the risk was easily a hundred times greater, and more sympathy was expended over one man 'casualtied' coming out than over a score of those killed in the actual fight." (5, p. 123)

Kreisler who spent four weeks in the Austrian trenches believes that a man becomes indifferent to danger if the organism is worn down and the brain and faculty of perception is numbed by physical exertion.

Norman Hall describing the attitude of a bombing party writes:

"They went to their places with that spirit of stolid cheeriness which is the wonder and admiration of everyone who knows Tommy Atkins intimately. Formerly, when I saw him in this mood, I would think 'He doesn't realize. Men don't go out to meet death like this.' But long association with him had convinced me of the error of this opinion. These men knew death or terrible injury was in store for many of them; yet they were talking in excited and gleeful undertones, as they might have passed through the gates at a football match." (27, p. 180)

If any general conclusion may be drawn from these few quotations, and the war literature contains many references to fear and death, we may say that soldiers experience fear, in degrees determined by individual differences, the situations in which they are placed and the intensity of the emotive state. Towards the death of comrades they are indifferent, due probably to the inner conviction that they themselves will not be killed, while to the customary dangers of normal trench warfare they become almost entirely indifferent. If fear is ambivalent in character, we would therefore expect the soldiers in the trenches to be comparatively cheery and hopeful and this is exactly what we find. Perhaps this surface gaiety, cheerfulness and indifference, has given rise to the belief

that the soldier does not fear. May it not be more plausible that these forms of behavior, dominated by the unconscious, are securities against fear, countervalent expressions whose source is the most persistent and primitive of all the emotions?

During the early days of the war, opposing armies prevented from fraternizing resorted to banter and to a certain degree within each army the same kind of raillery prevailed. President Hall has said that "Psychic jest and joy are greatest when expressed to overcome fear. To substitute a joy for dread constitutes a distinct element in laughter." (Lecture notes, 1916.) The humor of the trenches is naïve, often mere nonsense, but it banishes fear and puts despair to flight. In addition to the standard jokes are the soldier songs, mere parodies of national and patriotic airs or else typical vaudeville "successes" full of references to the female sex. Although the evidence is meagre there is sufficient to postulate that sexual subjects afford much of the material for conversation, jokes and songs. Environed with the horrors and filth of the trenches man loses the veneer of civilization, becomes bestial and unreservedly vents his strong sexual passions. In contrast to the vulgar, repulsive and regressive behavior, necessary perhaps for uncultured men to deaden the mind to more destructive forces, there are those who combat filthy jesting, who yearn to possess again individual freedom, who depend upon the higher sources of a vivid imagination, a dramatic sense, to drive away the fear element and to curb reversionary influences. A representative of this class writes:

"Probably there is no one to whom this saving grace is more essential than to the fighting soldier, especially in winter. Every detail of his life is sordid and uncomfortable. His feet are always damp and cold. He is plastered with mud from head to foot. His clothes cling to him like a wet blanket. He is filthy and cannot get clean. His food is beastly. He has no prospect of anything that a civilian would call decent comfort unless he gets ill or wounded. There is no one to sympathize with his plight or call him a hero. If he has no sense of the dramatic, if his horizon is bounded by the sheer material discomfort and filth which surround him, he will sink to the level of the beast, lose his discipline and self respect, and spend his days and nights in making himself and every one else as miserable as possible by his incessant grumbling and ill-humor." (28, pp. 194-5)

Apparently the number of men who rise above their environment, who master their passions, and retain a grip on personal acquirements is small, but all soldiers unanimously acclaim the humorous sense as a saving grace; it aids to dispel their fears and it creates a necessary atmosphere of cheerfulness.

In the trenches the men in a large degree feel detached

from the world. Some writers have declared soldiers seldom think of home and friends. If this is true it is because they do not have sufficient opportunity and we must remember the field of consciousness is limited. Carrington reports:

> "Letters from home, and journals, as they arrive, afford some slight, mental stir and commotion, for a time; but even these seem to leave no durable trace upon the mind, and their images and memories are soon obliterated. Thus a young corporal, in trying to analyze his impressions at the time, said, 'I am not sure that I thought of my family particularly, even when writing home! There seemed somehow to be a veil between us, shutting off all communion of feeling and interest between us.'" (9, p. 60)

If we can accept the personal character of the numerous letters as a criterion of the soldier's detachment from family and friends, there seems to be meagre evidence to prove that he is not conscious of them when writing. True, the men live practically in the senses, think only in a circumscribed manner, converse chiefly of simple things, resort often to gestures, and are dominated by the physical pleasures and pains but they do not entirely forget the past, certainly not their homes. N. S. Hall said that not once, during fifteen months of British army life did he hear a discussion of mothers, but he accounts for this by saying the soldiers realize the "futility, the emptyness of words in the face of unspeakable experiences."

The war has changed men's religious conceptions. R. J. Campbell states that there are not less than sixty thousand priests serving with the belligerents on all fronts which number does not include the priests of the Russian Eastern Church, or the protestant ministers serving with the British. (6, p. 13.)

During the early days of the war there were many accounts of supernatural interventions of which the best known refers to "The Angels of Mons" but these probably had their origin in the civil zone. Machen, I believe, justly claims credit for the Mons story (47). Religion in the trenches is shorn of its formality and ritual. The Roman Catholic adherents persist in observing their forms but the soldier's personal relation to a higher power has undergone a tremendous change. Not all, but the majority of the men become fatalists. Religion has been associated with observances and self-righteousness or with not drinking, not swearing, possibly not smoking and the avoiding of doubtful characters, and as trench life rather fosters most of these evils they do not want religion. Then their whole experience seems to negate the ideas they have of God and goodness. Furthermore the religious man

often worries, he weighs motives, is introspective and at times is doubtful if he is fit to die. Religion is to be avoided therefore because of this worry and its deterrent power, also because it stands as a sentinel against their immorality. Although they continually display many virtues such as unselfishness, sacrifice of personal safety and kindness, these are never connected with Christianity. There are exceptions. There are men inspired by lofty religious ideals, who feel impelled to battle or to serve in some way because of its righteousness. We can however justly affirm that fatalism prevails as the dominant characteristic in this respect.

One of the strange phenomena of the war is the great lack of hatred of the enemy, at least this is true of the British. Under peculiar circumstances such as when enraged by unnecessary violence or brutality, temporary states of intense hate may prevail but the trench warfare has been characterized by its absence. The soldiers do not revel in killing; they seldom think of the enemy in person; their warfare is mechanical. The prime motive for killing is self-preservation. They kill the enemy that they may not be killed. Such phrases as "I kill Fritzie because if I don't he will kill me," and "It was his life or mine" are very commonly expressed. Hankey perhaps has best defined the soldier's attitude:

"The Cockney warrior does not hate the Hun. Often and often you will hear him tell his mate that 'the Bosches is just like us, they wants to get 'ome as much as we do; but they can't 'elp theirselves.' At times he has regretful suspicions of the humanity of the Prussians and Bavarians; but they are not long-lived, and even while they endure he consoles himself with the proved good fellowship of the Saxon." (28, p. 91)

Even the sniper, who notches the butt of his rifle every time he scores a hit, will tell you he is is proud of his marksmanship, but he instinctively feels that every man he kills saves the life of a comrade. The artillerymen regard the enemy still more impersonally. They never see him in battle, yet they are subjected to intense fire from his guns. Their own success is reported by telephone, their fire is directed by observers and their attention, in an attack, is focussed upon comrades. It is only after the battle is over that they learn of their ultimate success or failure.

The effect of artillery fire is psychical as much as physical. The men behind the guns and those in the trenches have a greater nervous resistance when equal or superior to the enemy in shell power. Kreisler aptly puts it:

"The moral effect of the thundering of one's own artillery is most extraordinary, and many of us thought that we had never heard any

more welcome sound than the deep roaring and crashing that started in at our rear. It quickly helped to disperse the nervousness caused by the first entering into battle and to restore self-control and confidence." (37, p. 22)

Previous to the period of the attack it appears then that the soldier is motivated by the instinct of self-preservation and that he thinks little of the enemy in an abstract way.

Just as there are individual differences manifested in other phases of war, so before the period of attack and during the attack itself these persist. There are however more psychic and physical experiences shared by all during these occasions so that the dissimilarities are almost negligible. While waiting for the artillery to prepare the way, the men are in a state of tension, of extreme excitement and intense emotion. The heart beats faster, the hands tremble, the knees shake, the whole body is flushed with blood and it perspires freely. Crile has presented a valuable physiological interpretation of these phenomena. He says:

"His brain (the soldier's) is activated by the approach of the enemy. The activated brain in turn stimulates the adrenals, the thyroid, the liver. In consequence thyreoiodin, adrenalin and glycogen are thrown into the blood in more than normal quantities. These activating substances are for the purpose of facilitating attack or escape. As the secretions thus mobilized are utilized in neither attack nor escape, heat and the muscular actions of shaking and trembling are produced. The rapid transformation of energy causes a correspondingly rapid production of acid by-products. These increased acid by-products stimulate the respiratory center to greater activity to eliminate the carbonic acid gas. The increased adrenalin output mobilizes the circulation in the limbs; withdraws blood from the abdominal area; causes increased heart action and dilatation of the pupils. In addition, the increased acidity causes increased sweating, increased thirst, and increased urinary output, all of these water phenomena being adaptations for the neutralization of acidity." (13, pp. 19-20)

The few retrospections we have of this period invariably emphasize these bodily phenomena. They are the effects of a deep-seated cause. This is not solely the noise of cannon or the other concomitants of accustomed trench warfare for these are daily experiences. For months the trench has afforded shelter and protection, but soon the soldiers must go over the top, face in the open the hail of shrapnel, machine gun and rifle fire and if these are survived there must certainly follow the bayonet encounter. Experienced soldiers are not affected so much as younger men. The former say they do not fear but the latter are fearful. If we may judge their fears by their behavior the evidence is in favor of fear and to a lesser degree of anger being the causes of the physical and mental states. Fear is not present as a decision, "I fear

the future," or "I know death awaits for me," it may only rarely enter the focus of consciousness, but as an unconscious factor, a primitive and racial protection, it dominates the whole organism in the reflective hours before the charge. In this period the mind is clear despite the emotional stress. Thought is rapid, not abstract, but usually concrete imagery. Images of home, parents and friends, and memories of the past are vivid and pleasant, and even trivial incidents flash up. It is a common occurrence to exchange addresses and to pass on requests all relating to relatives; instructions in case of death. In a dim way most of them feel they will survive; they never reason about death yet they do not forget it. Some become reckless, and need to be restrained from jumping over the parapet, others are sustained and inspired by lofty feelings. As the crucial time approaches the memorial impressions fade and the attention is directed upon the enemy and the means of protection. One man said "Fear is before the blood is hot, or when told of the attack" and it is reasonable to believe that fear of danger, of open places, of unseen and uncontrollable forces, and for some perhaps of death itself, initiates the varied behaviors, physical and psychic, in this stage. As a result of the glandular secretions and the corresponding mental strain muscular activity becomes necessary, naturally therefore the first feeling experienced when over the parapet is one of relief. One soldier relates that upon the command "Fix bayonets!" he had a sinking sensation, a feeling of collapse, and his hands trembled violently but a sudden change occurred when commanded to charge. (35a, p. 39.)

The charge marks the culmination of the process of psychic degeneration; there is a complete abeyance of the mental processes, a final narrowing of the psyche. All images and other impressions extraneous to the great directing instinct of self-preservation entirely vanish. The mind is focussed upon one end, to protect the self. To get to the enemy as soon as possible is now the great desire but there is no haste in the forward move. Here lies a difference between the French and British. The former rush impetuously and intrepidly, the latter follow with precision the steadily advancing barrage. Some regiments, especially the Scottish, brandish their arms, shout and utter loud cries, while others are dogged, silent yet irresistibly determined. A peculiar elation takes possession of the mind comparable to a feeling of buoyancy or exhilaration. Every vestige of fear vanishes; it has passed over into anger and the positive bodily actions necessary to

preserve his life. Man is now a brute-beast, shorn of his higher instincts and culture. He is aware only of the group which he unconsciously feels affords protection. He takes no notice of his fallen dead comrades, at times he may use their bodies for cover, while even the cries of the wounded do not deter him from pressing forward. Stretcher bearers who advance with the infantry tell us the faces of the attackers bear savage expressions similar to preying animals. Like animals, only one idea, viz., self-preservation, dominates consciousness, and this is best assured by killing as many of the enemy as possible.

When he meets the enemy his purpose is complete destruction. He does not think of him, there is no pity, no sentiment, no thought of chivalry. Some mysterious force seems to impel him forward. During the earlier stages of the war there was no animosity, no hatred; the man he killed was not a person, a German, but simply an enemy. Recently this has changed because of the outrages which the men have witnessed so that anger and intense hatred are powerful activators. The following quotation characterizes what was the attitude of most soldiers:

> "I asked Zeni Peshkoff, socialist, what his sensations were when he went out to kill. 'It didn't seem real, it doesn't now. Before my last charge the lieutenant and I were filled with the beauty of the night. We sat gazing at the stars. Then the command came and we rushed forward. It did not seem possible I was killing human beings.'" (M. Z. Doty. Short rations, pp. 61, 62)

The first contact of the soft body of the enemy upon the bayonet and the gush of the hot blood produces a sensation of horror which almost paralyses the victor but this soon passes off as he realizes the more he kills the less chance there is of being killed himself, in fact this horror finally becomes a thrill of pleasure. To cite from Carrington's article; a man was asked whether he felt horrified when he bayoneted his man,

> "Not at all," he replied; "I had a curious sensation in my arms as I felt the soft body, and I grew fatigued with continued fighting. But the action was of such short duration, and I felt all the time so keenly that I was fighting for my life, and seeking only to preserve myself, by killing the enemy that I gave no thought to him." (9, p. 66)

From this he concludes "The act of killing does not shock; that is established beyond a doubt." Such a conclusion overstates the actual effects for the impression made upon the nervous system, and conserved in the unconscious, at some future date may possess the soldier's mind, causing severe mental disorders. Just as the soldier thinks only of the enemy,

so he ceases during action to be governed by the ethical code of the civilian. He does not question the morality of his acts, he never thinks of it. In a similar manner he is unaware of the bravery of his deeds. Courage is now determined by circumstances and the emotional intensity; it is not the result of reason and does not necessarily depend upon physical prowess and strength.

The attack emphasizes the importance of the officers and of the long period of trench discipline. As a result of the intensive training, in actual combat it is easier for a single principle to sway the whole being; for the mind to become non-rational and simple. The officers must now direct the proceedings entirely, they must determine the extent of the attack for the men are intent on their own protection, the killing of the enemy, and in this they require both encouragement and restraint. Furthermore the leaders determine the morale of the troops who instinctively are imitators and who regard their officers as symbols of duty, discipline and the nation. At times the loss of an officer may terrorize a company and cause disaster to a regiment.

Other occasions of conscious fears are few during combat perhaps the typical one being that of isolation from the group, when fear results in flight or other means of escape.

While the charge represents a regression in phylogeny and initiates a period of control by instinctive reactions where the emotions and behavior function for self-preservation, it does not parallel the stage of the love of killing nor even animal levels entirely. Only in rare cases will a soldier kill the enemy when he signals his surrender which goes to prove that the theory of struggle in a causal sense is ever subject to the real, deeper motive of protection.

The intensity of the fighting produces great physical changes. Usually the soldiers leave the battle fatigued, showing signs of the strain on their faces and limpid bodies while often they are hysterically cheerful, probably due to the nervous reaction. The ordeal upon reflection seems a long one, as one man in answer to the question "What sort of a week have you had;" put it, "It hasn't been a week, son, it's been a lifetime!"

In modern trench warfare armies seldom suffer a retreat, but usually a series of repulses. The attackers and defenders experience similar psychic changes except that the latter if subjected to intense bombardment suffer from nervous collapse due probably more to physical katabolism than to psychoses. If reverses are common there follows a lowering

of the morale. A retreat may be of the nature of a panic, when fear, rising above the unconscious, gains the final path, or it may, as it often is, be a methodical falling back, marked by continued fighting. Artillery support has changed the nature of fighting so much and the contestants are so evenly equipped that to put an intrenched army to flight is almost an impossibility.

In the great retreat through Belgium and Northern France the factor of fatigue was important as a determinant of conduct. At first the men were surprised, then discontented and resentful, and later owing to the loss of sleep and a resulting fatigue they grew apathetic, indifferent to the finer sensibilities, to sorrow, hope or happiness, until anger, rage and discontent supplanted their opposite emotions. The mind is concentrated upon the body which is oversensitive to pain. It appears that the visual and auditory thresholds are raised for they no longer function efficiently. Just as in the charge so now behavior is a reaction to the protective instincts, but whereas in the former the glands function excessively, thereby increasing nervous and physical resistance, in the retreat such secretions are prevented by the toxic products, due to fatigue. Finally the desire for sleep is more powerful than the will to live; the mental yields to physical demands. So men slept when marching; when in position for firing sleep overcame them; they slept when death was near; some were captured asleep. This great continued retreat, lasting nine days, during which men marched one hundred and eighty miles burdened with their equipment, fighting losing battles, and at all times held in check by promises of ultimate success and needed rest, illustrates the tremendous sustaining power of the psychic and nervous mechanisms.

When the moment of the advance came after a brief period of rest the weakest men were brave, all experienced feelings of elation, they were lifted above their apathy, and the whole physical organism tingled with excitement. Of the many factors producing such a transformation the important are: the opportunity to meet the foe upon equal terms; the release from continued purely defensive effort, or the thrill of the offensive, of superiority; the powerful motive of revenge; and the desire to excel in heroic actions, which is an imaginative reverie.

Soldiers wounded in the charge or retreat are not aware of the degree of their injury until unable to use the affected member. Thus a rifle bullet causes a burning sensation which passes unheeded when not received in a vital organ, and some men who had a limb shot away said they did not notice it

until they fell on the shattered stump. If able, wounded men instinctively seek cover either near at hand or they crawl to the trenches. When conscious the rational processes often return, the men think of more severely wounded comrades; they are chivalrous, heroic, brave, they will seldom monopolize ambulance facilities until these are removed. This is not the bravery of unreflective moments, it does not parallel the heroism of the charge, for the men realize their danger, and they are torn by fears. It is due to the reassertion of the higher mental processes, to the establishment of the normal relation of the conscious and unconscious which again function the sympathetic emotions. If cognizant of immediate death their thoughts are of home, and sometimes of God and the future, but just as often they ask about the result of the battle and the welfare of comrades.

No generalization can be made about the psychic states of the wounded as these are determined by the seriousness of the injury, more especially the organs affected. In the same ward are men whose language is obscene, who curse God and country, who rave about sex and immoral conduct, who rail their neighbor because his gangrenous wound emits nauseating odors and whose only thought is of a world turned against them; while others are courteous, childish in simplicity, mindful of comrades and nurses, who bear pain stoically, who seek comfort in religion and who often think of home and family. If they know they cannot return to the fighting line their attention is focussed upon the immediate present, the future is too uncertain, too terrible to contemplate; these painful thoughts apparently are suppressed unconsciously. Few in number are those who anticipate with pleasure the return to combat, the majority abhor war, their experiences are too unreal, too horrible, and usually their reply to questions of the future are, "It's the business of war," or "*C'est la guerre, que voulez-vous.*" When asleep their dreams are about the enemy, the battle and their part in it; they cry out, pull their bandages off and often endeavor to leap out of bed even though severely wounded, while many others are disturbed with sexual phantasies, which likewise are communicated by word and action. We cannot therefore generalize or point to a typical psychic state as in the charge but we may believe that to these men war is repulsive, not to be discussed, and that the present is all-important.

To what extent the experiences of the great war affect the soldier-citizen in his re-established civic life is for the future to disclose.

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VISUAL, CUTANEOUS, AND KINAESTHETIC GHOSTS

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A. Introduction

The questionnaire method, which has been so often employed in this occult field of psychology, has failed to yield sufficiently consistent results to enable one to formulate a satisfactory theory of visual ghosts. Unfortunately, ghost stories, like fish stories, are too often either pure creations or gross misrepresentations. People can always be found who deliberately distort facts as long as they realize that no one is qualified to contradict their statements. False ghost stories are often motivated by beliefs in the supernatural, or by the mere desire to interest or scare others. A ghost story of one who has been trained from his cradle days to be an aggressive spiritualist, is generally of a more exciting nature than one told by an anti-spiritualist. Ghosts and rumors of ghosts have ruled societies throughout the ages of human history; and the reign of the rumors has perhaps caused the greater terror. Those investigators, who have made use of the questionnaire method, failed utterly to distinguish between ghost and mere rumor. We shall censor these stories and shall limit ourselves to only those ghosts such as have been produced and reproduced under controlled conditions.

It is a duty of the psychologist to attempt to account for the fact that a *limited number* of people, apparently of all races, have observed certain appearances which they have been willing to call ghosts or spirits. The visual ghosts will be of primary interest to us; but, in order to make our theory more comprehensible, we shall discuss also a number of other phenomena which are fundamentally the same as the visual ghosts, and which are fortunately not shrouded in super-

stition. The latter phenomena we may profitably call cutaneous and kinaesthetic ghosts.

B. Visual Ghosts

1. *The Nocturnal Visual Ghost*

Experimental results indicate that this traditional ghost is only a *positive after-image of long duration*[1] which becomes revived by a stimulus of such extreme insignificance that the *immediate* visual effect produced by it may find no place in the ghost story. If we choose to speak in Pawlow's terminology, we may call this ghost a *conditioned* visual response to a previously perceived more or less complex pattern of visual stimuli.

In a previous article[2] I related one of my experiences with the positive after-image which I suggested might be of interest to spiritualistically inclined persons. This was an account of my illuminating my retinas through my closed eyelids and thereby reviving a positive after-image which I had experienced about fifty minutes before. Recently I have succeeded in reviving remarkably distinct positive after-images from six to eight hours after the original ones were experienced. I waited in the darkness from five to ten minutes, and then fixated and illuminated my hand or a particular white surface steadily for about one second. I observed a continuous positive after-image which often lasted as long as a minute and a half. Then, after sleeping six or eight hours in a very dark room, and before opening the eyes, I illuminated the retinas with a flashlight, but so very slightly that I did not become aware of the red of my closed eyelids. Not every morning, but sometimes, the after-image was revived. It occasionally appeared in almost its original distinctness, and once or twice it endured about as long as originally. The ghost frequently appeared the first time the retinas were slightly illuminated, but sometimes it did not. When the first trial proved unsuccessful, I illuminated the retinas again and again until it did appear, or, until I gave up in despair. I have succeeded in reviving a single positive after-image a number of times, but not in immediate suc-

[1] A positive after-image of long duration and the essential conditions for obtaining it are described by Helmholtz in his Physiologische Optik p. 504. On p. 506 he states that the positive after-image of bright clouds viewed thru a window for about ⅓ second, disappears after about 12 seconds.

[2] Positive After-Images of Long Duration, this Journal, XXVII, p. 334.

cession. I made each time a pause of just about as many seconds as the ghost had remained with me, and then I slightly illuminated the retinas. When this rule was strictly obeyed, I found it possible to revive the after-image five or six times in this slow tempo. It seems that, in order to revive an after-image after such a long lapse of time, the retinas must be illuminated just as the otherwise unnoticeable positive after-effect is on the verge of reappearing. That a positive after-effect does reappear a number of times without the retinas becoming reilluminated, is a matter of frequent observation. It is observed to grow fainter and fainter until it can be no longer detected; and we shall assume that at least some of the visual structures involved, continue thus periodically to refunction for an indefinite time. This, we shall suppose, is especially the case when the individual is inclosed in darkness, under which condition the retinas are not being strongly stimulated.

If my retinas should have become similarly illuminated in the morning by something which was not under my control, as was the flashlight, I should very likely have seen a ghost when I was not looking for it. This would more likely occur if I should turn out the light, and, after remaining in the darkness for a few minutes, turn on the light for a short interval, perhaps to see if a certain article is in its proper place. If my retinas should happen to become properly illuminated a few hours later, I should very likely see a ghost of the last observed object. If such should appear during my sleep, I should be inclined to call it an unusually vivid dream, the nucleus of which is this object; I might just as well consider it a revived positive after-image or a ghost.

Let us now imagine the following possible conditions. Two persons, A and B, are in a room and are ready to go out. A turns out the light, and they depart in the darkness together. After a few minutes, B discovers that he has forgotten his watch, and they both return. A turns on the light long enough for B to get his watch and looks at him during the short interval. They then go away for good, separate, and A's path leads him through a dark forest. While in the forest, he chances to pass through a small glade and thereby slightly illuminate the retinas just as the ordinarily unnoticeable positive after-effect of B is on the verge of reappearing. In the darkness beyond the glade, A will then see a ghost of B, but will he recognize it as B's image? These ghosts are not always so distinct and clearly defined that one can say with certainty that it is the image of this and not

of that person. If A should be spiritualistically inclined, we might expect him to say, "Oh, that's the spirit of my dead friend." He may, in telling his ghost story, relate how the spirit or ghost of his dead friend approached him one night in a dark forest; how it floated about him for a time; and how it then either gradually or suddenly vanished; and not even think of mentioning the fact that he had just walked through a glade.

There are many other conditions under which the ghost might appear. On a dark cloudy night, A might be walking in the open when the moon chances to shine through a small break in the clouds just at the right moment to revive the after-image. A might also glance at a distant light, or even at a near-by bright surface which stands out in the darkness, such as a white tomb-stone he sees while passing a graveyard. Or, if he should be brave enough to approach a deserted house or castle, where, as he has been told, horrible crimes have been committed, he might be expected to glance rather carefully at all the bright objects near him; and furthermore, what is equally important, he might be expected to walk rather timidly and occasionally stand perfectly still. This latter condition is important, because a positive after-image of long duration does not appear, or, if it has already appeared, it either grows weaker or vanishes completely when one makes a pronounced sudden movement. Experimental results indicate that A might easily keep the ghost away by whistling. He might also put the muscles of his body under tension, perhaps slap his hands together, or shake his fists in the air, and make the further consistent response of saying, "I am not afraid," and thus reach the house or castle without being intercepted by a ghost.

The two following ghost stories are typical of a large number of the many hundreds which have been related to me since I first began serious investigations in this field. A certain French duke, while sleeping in his château, was awakened by a peculiar knocking at his door. Almost immediately, a human figure with two heads entered through the closed door, floated about in the room for a short time, and then gradually disappeared through a wall. This gentleman related his experience to an elderly lady who was at the same château. In an excited way, but with an honest look, she said, "Just about two months later, I had *exactly* the same experience. I was awakened by *exactly* the same knocking at the door, and, thinking it was a maid, I said, 'Come in,' but no one responded, and I thought immediately of the two-

headed person. Well, as you may imagine, my heart almost stopped. I was absolutely *powerless,* and I did not dare look around, because I knew that two-headed person was there behind me." When I asked her if she saw anything, she replied, " No, but everything told me it was there *just* behind me." If this lady had been untruthful enough to emphasize her ghost story by asserting that she really saw the ghost, I should have considered this a typical case of contagious ghost seeing. Or, if she had glanced at a bright object before she became 'powerless,' as the duke perhaps did when he heard the noise, she might have thereby really caused a positive after-image of some previously perceived visual pattern to be revived. This would have been a case of real ghost contagion, due to the fact, however, that the duke's story caused her to behave in an ideal way to cause an after-image to be revived. The duke's story caused her to become, as she expressed it, 'powerless'; and we might here remark that a fixating person is a 'powerless' one. It might also be mentioned in this particular connection, that a fatigued person is likewise, often at least, a fixating person. Observations seem to indicate that the well known hypnagogic phenomena, which appearances are fundamentally the same as our ghosts, generally arise under conditions of unusual muscular fatigue. That the duke's ghost possessed two heads, is nothing unusual in a positive after-image. One can easily obtain a similar effect by fixating two persons, one of which is somewhat behind the other, by turning the head to the right or to the left while fixating a single person, or by holding the head and the eyes still while the fixated person moves only the head.

There is really no apparent reason why many of the traditional ghosts should not be the revived positive after-images of deceased persons. In this connection it is interesting, that while observing corpses, people are not ordinarily engaged in making such pronounced movements as are involved in the activities of dancing, laughing, whistling, or perhaps singing such popular songs as are accompanied with pronounced bodily movements. On the contrary, even those who do not actually weep often stand before the corpse and fixate it carefully, sometimes so very carefully that many of the objects in the field of vision subjectively disappear. Others, in weeping, shut out for a long time the light rays from the eyes, take another glance at the corpse, and then weep again in the same way. The weeping is often, at least after several hours of frequent weeping, of a rather silent nature, in the

sense that no very pronounced movements are involved in it. These are ideal conditions for preparing one to see ghosts. It is by no means necessary that the mourner should at the time see what we call a positive after-image of the corpse; for a large part of the percept is, after the first few moments of exposure, no longer dependent upon the objective stimulus for its continued existence, and is therefore fundamentally the same as the positive after-image which, under the condition of darkness, exists independently of the objective visual pattern. The positive after-image is evidently in progress while the surface is being observed. It is only the positive after-image, and not the entire percept, which can be revived by an insignificant visual stimulus; the entire composite visual experience can be revived only when the original objective pattern is presented under exactly the same conditions as previously.

If the mourner should leave the corpse and pass immediately into the darkness, the likelihood of his later seeing a ghost would be greater than if he should leave and remain for a while in daylight, where the retinas become in the meantime strongly stimulated in a variety of ways. In this connection, I must recall the fact, that after I had spent about forty minutes in a well-lighted room, and then about ten in the darkness, a ghost of a previously fixated person appeared when I illuminated the retinas through the closed eyelids. Whether this was the ghost of the person as I last saw him in the light, or whether it was the revived after-image of him which I had observed about fifty minutes before in the dark-room, I now feel unable to say, for, as I distinctly remember, he stood before me in about the same way in both instances. However, a few persons insist they have seen ghosts of me even many days after I showed them a positive after-image of myself. It seems as if the Chinese see such ghosts more frequently than people of other races. This, I think, should be considered in connection with some of the facts I reported in my article on 'The Biological Significance of Eye Appendages of Organisms'[3]; a study of this sort might possibly throw considerable light on many of the traditions of the Chinaman.

We have previously assumed (p. 2) that at least some of the structures involved in producing an after-image pattern periodically refunction for an indefinite time; and, that if when these few structures are just on the verge of refunc-

[3] This article has been accepted for publication in this journal, but has not yet appeared.

tioning, the retinas chance to be restimulated in somewhat the same way as originally, these, and also many other visual structures which previously functioned simultaneously with these, will refunction and accordingly produce a distinct positive pattern. This postulation was made in order to explain the fact that a positive after-image can be revived only *occasionally* by a given insignificant stimulus. Certain facts seem to support our assumption. It is not a theory, but a matter of observation, that a positive after-image often alternates with a negative after-effect of about the same duration. When the positive effect lasts thirty seconds (this seems to approximate the maximum duration for the normal untrained individual who fixates carefully), the duration of the negative one is also just about thirty seconds. After only two or three alternations, however, the negative effect of the white surface can be, as a rule, no longer noticed, while the positive one may be detected still several times. As I pointed out in the article on positive after-images already referred to, (p. 331 of that article), if the retinas become again illuminated in the same way just as the faint positive after-effect is on the verge of reappearing, the resulting after-image is unusually distinct. If the retinas become reilluminated with the previously used pattern just after the faint positive effect has vanished, a distinct positive after-image generally follows, but observations show that this one is almost invariably less distinct than the one which is caused to occur simultaneously with the faint one. On the other hand, this positive after-image is often of much longer duration than when it is caused to coincide temporarily with the faint one. Apparently, the duration of this effect amounts to the duration of the directly produced effect plus that of at least a part of the ensuing one that now becomes revived to an extraordinary degree of distinctness by the visual responses which are in progress when the otherwise faint after-effect begins to reappear.

Let us call this directly produced after-image A, and the periodically appearing positive after-effect which this time follows A, let us call B. Since both A and B consist of many visual responses, we may speak of the A- and B-responses, or of the A- and B-patterns of simultaneously occurring responses. A occurs, e. g., 15 seconds before B, but A is still in progress when B appears, and consequently, B is revived to unusual distinctness by the responses of the A-pattern. If this occurs frequently, the A- and the B-patterns become associated in the particular order AB, and later, when no positive effects of the objective pattern can be observed, great

numbers of the B-responses follow when only the A-pattern is produced directly. We should certainly expect that if positive visual responses can become associated to form a pattern of simultaneously occurring ones, they can also become associated in a serial order to form a positive pattern of longer duration. I am convinced, that through just such a procedure, I have trained myself to see positive after-images which now last for a minute and a half. Originally they lasted about one-third as long as now.

Another step which I took to increase the duration, and also the distinctness of the after-image, was to greatly diminish the eye movements which I found occurred almost invariably for a few seconds after the retinas were subjected to a sudden change in illumination. The eyes moved from side to side or up and down in various tempi, but usually in that of approximately 0.38 seconds, or about twenty-six times in ten seconds. I learned that, by frowning in a particular way, I could inhibit in a large measure all of these except the first movement. Only after much practice I became able to suppress this one to such an extent that it no longer caused a break in the positive after-image. When I do not suppress these movements, I am able to distinguish the cinematograph positive after-image and then a pulsating one of long duration, such as C. A. Young[4] described in 1872. The discontinuity of the positive after-image is more pronounced when the period of illumination is extremely short; but in any case, one can make the image continuous by carefully fixating, which process involves suppressing especially the eye movements. As Miles[5] has shown, it is possible to periodically illuminate the retinas in such a tempo that the usual pulsating positive after-image becomes not only a continuous effect, but also one of very long duration. Miles found it best to reilluminate the retinas at the rate of about four times per second. This tempo very closely approximates our tempo of eye movement which fluctuates, with different individuals, slightly above and below 0.38 seconds.[6] It would then seem

[4] Phil. Mag., XLVIII, p. 343.

[5] George H. Miles, The Formation of Projected Visual Images by Intermittent Retinal Stimulation, Brit. Jour. of Psychol., VII., 1915.

[6] Miles also observed certain involuntary movements of the eyelids (I think these were evidently due to the movements of the eyeballs) which, according to his rough estimate, occurred in the tempo of about 0.4 seconds. The effects of the eye movements can be observed unusually well if the retinas become strongly illuminated for a very brief time interval, and then a phosphorescent patch in darkness is observed. The objective stimulus appears to move in the horizontal or vertical direction in the tempo of about 0.38 seconds, thus producing alternately light and dark spaces where it at any time seems to lie.

that, in order to convert the pulsating positive after-image into a continuous effect, we can reilluminate the retinas at the beginning of each dark space.

II. The Diurnal Visual Ghost

The traditional ghosts which fall in this class are such as the revived positive *after-images* and *after-forms* of idols, sweethearts, corpses, or handwriting of particular persons; and they appear in daylight or by artificial light, usually in or on such backgrounds as smooth walls, open fire-places, clouds of whitish smoke, rainclouds, or deep walls. We are not concerned here so much with revived positive after-images as with revived positive *forms* of objective visual patterns. A positive after-image is the pattern of visual responses which is produced directly by the objective pattern fixated, and which may persist after the pattern is removed. The positive *form* which is of primary concern to us here, is the positive after-image plus the negative effect of the background of the fixated pattern; this negative effect coincides with the positive after-image, or in other words, it *assumes* the *form* of the pattern and this induced negative effect of the background and the positive after-image can later be revived simultaneously. Before discussing the *form* of the pattern, it would seem well to consider briefly a certain peculiarity in the behaviour of the mere positive after-image which can be revived in the daytime.

Hering[7] fixated a gas flame for about twenty seconds and then directed the eyes to a strongly illuminated white paper. He observed first a negative after-effect of the flame which soon passed over into a distinct positive one. He called attention to the fact that that portion of the white surface on which the positive after-image of a bright object develops, may be much brighter than the remainder of the white projection field. McDougall[8] fixated a white surface, waited until he could no longer detect any sort of an after-effect of it, and then revived the original positive after-image by turning the eyes to a white background. He also found that upon blinking, the positive after-image reappears and frequently remains for a few seconds after the lids are opened. Baird,[9]

[7] Ewald Hering, Zur Lehre vom Lichsinne. Wien, 1878, s. 44.

[8] W. McDougall, Some New Observations in Support of Thomas Young's Theory of Light- and Color-Vision, (I), Mind, N. S., X, 1901, p. 55.

[9] J. W. Baird, The Color Sensitivity of the Peripheral Retina, Published by the Carnegie Institution of Washington, Wash., D. C., 1905, pp. 57-59.

also, calling attention to the fact that the effect of a visual stimulus may persist for an unusual time, and too that it may be entirely sub-liminal, made the following statements which should be of considerable interest to us: "A surprising fact in connection with these after-effects was the observer's utter ignorance of their existence. . . . We can only conclude that the functioning of the peripheral retina is followed by an after-effect which is tenaciously persistent and is wholly latent in character; and that this sub-liminal capacity is called into active functioning by subsequent stimulation." Troland's[10] researches lead him to make the following statements: "By use of dimming, after-images can be demonstrated for pre-exposures of an eighth of a second, which leave no noticeable trace on the undimmed field. . . . If the projection field is brightened, the faded negative after-image is *reversed,* and becomes positive. . . . The positive image fades on the brightened field, but upon dimming and rebrightening, again appears."

The revived after-images here mentioned may be anything, a positive one or any of the possible negative ones of a flight of colors which may follow after stimulation with a given color. As to what the particular qualitative nature of the first revived after-image is, depends in the first place upon which one of these possible ones happens to be in progress when the retinas are reilluminated, and in the second place upon the qualitative nature of the stimulus used for reilluminating the retinas. If the eyes are directed to an illuminated black surface, at least many minutes after a white object has been fixated, a negative after-effect can sometimes be observed; but, as Hering pointed out (however, in a special case) this soon gives way to a positive effect; and we might here remark that it is occasionally of an hallucinatory distinctness. These few special cases we shall call diurnal ghosts. The black background revives only indirectly the previously established pattern of white-responses. It produces directly great numbers of black-responses, some of which are associated with and call forth some of the white-responses, and among others, the associated cluster of them which is our previously established positive pattern. If the background is white, the positive white pattern may be produced directly, and the pattern of the previously fixated black background is then produced indirectly. We should never forget that we must reckon with

[10] L. T. Troland, The Influence of Changes of Illumination upon After-images, Paper read before the Amer. Psychol. Assoc. at New York, Dec., 1916.

the entire or general pattern and not alone with any small portion of it. When any portion of the general pattern is caused to recur, all the other portions may reoccur with it, and in the same temporal order as previously, which means simultaneity. Thus when the eyes are closed, a positive after-image of a white pattern may be revived indirectly, but immediately, because when the pattern of the black-responses is caused to recur, the pattern of white-responses occur with them to form a portion of the previously established general pattern.

Our argument concerning the existence of the positive pattern of a white object on a white background, naturally leads us to conclude that the distinctness of the visual effect is dependent upon the number of white-responses which occur in a unit of time when the given retinal areas are stimulated. When I direct the eyes to a white surface, my percept of that surface is characterized by a certain degree of whitishness, and if I make the surface objectively still whiter, the percept is now characterized by a still greater degree of whitishness; which indicates that the first stimulus did not call forth all the white-responses which I, as a visual organism, could manifest when the retinal areas in question were stimulated. The fact that the particular area of a white background upon which the previously established positive pattern of a white surface appears, is unusually whitish, would mean that the effect observed on this limited area is due to a large number of directly produced white-responses plus some others which could be indirectly produced by virtue of the fact that they were previously associated with some of those directly produced ones. Another way of discussing this matter is to say the objective stimulus produces, among many others, some of the responses of the positive pattern directly, and the others of the pattern occur simultaneously with these as previously.

But when we fixate a surface steadily for many seconds, we have still more to consider than the mere positive after-image of the fixated surface. This leads us to a consideration of the *after-form*. If I fixate a white area which lies on a large illuminated black background, the white surface will ultimately disappear. This occurs for two primary reasons. In the first place, the white-structures that function become highly exhausted and give way to black-responses which are associated in this particular temporal order with the white-responses;[11] and in the second place, the white of the white

[11] I do not see fit to take up space here to suggest why this association exists. I shall simply consider the fact that such an association is established.

area and the black of the black background previous to the exhaustion of the white- and black-structures, induce themselves over one another,[12] and finally there is no border line left between them. In the final after-effect, I notice that the two colors have changed places. We can better express what here takes place if we let W stand for the directly produced pattern of white-responses, Bk′ for the black-responses which are associated with and follow the white-responses of W, and Bk″ for the positive or self-induced effects of the neighboring black background. The distinctness of the negative after-effects of the white surface would then be dependent upon the distinctness of each of the two components Bk′ and Bk″ in the absence of W. The expression B′+Bk″—W indicates clearly that we must observe black when the white is removed. If we leave Bk″ out of account, as we can do in a degree by illuminating the surface for such a short time interval (from about ⅛ to 1 sec.) that the simultaneous self-induced effects are negligible, we find that the negative after-effect which follows the positive after-image of the white surface is very indistinct, and that it is in some cases not even noticeable. But Bk′+Bk″ form, in the absence of the objective white, a remarkably distinct after-form, and this form is all the more pronounced if the black background is, relative to the white area, quite large; *of two unequal areas of qualitative sameness the self-inductive effect of the larger one is the greater.* The distinctness of the negative after-form of the black background is determined by the distinctness of each of the two components, W′ and W″, in the absence of the objective black. Our shorthand expression which signifies the quality of this negative after-form would be W′+W″—Bk.

To further illustrate the fact that colors induce themselves over one another, we may form a double pattern of adjoining white and blue areas and carefully fixate a point on the border line between them. After this pattern has been fixated for only four or five seconds and the retinas are inclosed in darkness, we observe in place of the white a blackish blue and instead of the blue a whitish yellow. The self-induced blue can be seen even in the daylight if we fixate the pattern carefully for thirty or forty seconds. If the room is made

[12] The fact of the positive simultaneous induction has been recorded, first by Rollet, and then by W. McDougall, Some New Observations, etc. (111 conclusion), Mind, N. S., X, 1901, pp. 348-353. See McDougall's reference to Rollet and the quotation given on p. 349 of the article just referred to.

dark while the induced blue is quite distinct, *this self-induced blue often remains positive for many seconds.* This would lead us to suppose that when the fixation continues for only four or five seconds, there is a sub-liminal blue induced over the white; that there is a sub-liminal white induced over the blue; and that these self-induced effects remain positive and merely become prominent when the objective stimuli are removed, as when all light is shut out from the retinas.

If a patch of paper which is qualitatively more similar to the blue than is the white is placed on the white area, this will become bluish more readily than will its white background. This patch does not need to be objectively bluish; it is quite sufficient if the similarity is one of brightness only, and the patch by no means needs to be of the same brightness as the blue; it can be a gray that is only somewhat blacker than the white. *The blue induces itself over both the white and the gray, but the more strongly over the gray which is the more similar qualitatively to the blue.* A variety of experiments show that *the greater the qualitative similarity between two areas, the more readily do the colors of these areas induce themselves upon one another;* and it is to be remarked that *this self-induction apparently does not heed retinal distances.* That these simultaneously self-induced colors seem to occur independently of retinal distances, would seem to indicate that the self-induction does not take place in the retinas, but at some place farther back in the visual organism.

If we carefully fixate from five to ten minutes such a pattern as any of those just mentioned, and then wait until no after-effect of it can be observed, the entire positive form of the pattern can often be revived with all the contrast effects, if we remain for a time in weak illumination and then fixate such a bright surface as a field of snow. The positive after-form of a white object soon disappears on the snow, giving way to a negative one; and the second positive after-form that appears, if it appears at all, is as a rule very indistinct. If now, after having fixated the snow, we decrease the illumination on the retinas by turning the eyes to a dark wall or by passing into a moderately well-illuminated room, everything in the visual field is often negative at first; but as the general negative effect fades, the positive form of the previously fixated pattern often comes into prominence. If the pattern fixated is made up of two adjoining areas of red and blue, this pattern can be revived by looking at the snow, and the red and blue may change places a number of

times before they completely vanish.[12] After they vanish, they can be again revived by directing the eyes for a short time to either a blue or a red surface, by closing the eyes so long that the red of the blood-saturated eyelids can be noticed, or by walking rather rapidly on the east side of and very near to a high picket fence through which the low western sun shines. The difference here between the positive and negative after-forms can be determined only by remembering the previous relative positions of the red and blue in the objective pattern; if the objective red lies to the right of the blue, and this same relative position of the subjective colors is present, the revived after-form is positive, otherwise it is negative. Thus the positiveness or negativeness of the general pattern is experienced only as the one or the other of the two possible positions of the colors.

One of my former students, in an attempt to observe what he had heard me speak of as 'the positive after-images of long duration,' fixated his mother for many minutes and then passed into a room which was only moderately dark. After many such attempts he succeeded in reviving a distinct positive after-form of his mother's face. He later complained to me that he had very much difficulty in securing the 'positive after-image.' He said it was quite distinct only a very few times, and that it was generally not to be recognized. When he told me of the odd method he used, it became at once evident that he had misunderstood the instructions, which had fortunately never been explained explicitly to him. I have followed out this new method of procedure, and a few times I have succeeded in reviving the positive after-form of the person's face by turning the eyes alternately to white and black backgrounds. Once I succeeded in seeing the white of one eye. The other eye had the appearance of a mere dark cavity in the head. As a general rule the eyes are represented by mere dark spaces, the nostrils seem to be very much inflated, the nose seems unusually short, the cheeks unusually hollow, and the ears are often two or three times their natural length, and quite pointed.

I recently discovered that if one fixates for five or six minutes, e. g., a moderately well-illuminated person, somewhat peripherally, and then steadily fixates a point on a large

[12] For the first description of this behaviour of the red and blue pattern on the snow, I am indebted to Mr. W. C. Bock, Research Fellow in Psychology at The Ohio State University. Mr. Bock said the red and blue once interchanged two or three times before they disappeared completely.

smooth wall for three or four minutes, perhaps in one trial out of fifty a ghost of the previously fixated person appears and stands out as if in high relief on the wall. When this ghost appears, it usually remains for only about four seconds, but after a lapse of about four seconds it reappears. I have observed it to appear thus perhaps as many as twenty or thirty times; fourteen such periodic appearances is the greatest number I have actually counted at a single sitting. Often the features of the person can be seen remarkably well, but sometimes the eye regions are too dark, the nostrils too large, and the ears too pointed to enable one to say whether it looks more like the person fixated or the Devil.

In this experiment, the visual structures for the color of the wall were first highly exhausted by steadily fixating the surface for three or four minutes so that the visual responses, which the wall at first called forth, would play an insignificant rôle in inhibiting the positive after-form of primary interest. The muscles of the iris became in the meantime well recuperated, began to contract and expand, and thus caused the peripheral regions of the retinas to become differently illuminated in the slow tempo of about four seconds. At each expansion of the pupils, the ghost appeared, and it remained present until the pupils contracted, thus darkening the retinas and accordingly reviving the negative form of the pattern. One outstanding fact is that when one breathes slowly, the ghost remains longer each time, and it is easily observed that the fluctuations in the size of the pupils tend, under these conditions, to occur in the same tempo as do the movements involved in breathing.

It would seem reasonable to suppose that in this particular experiment the peripheral ghosts are more easily obtained than the foveal ones, merely because the peripheral regions of the retinas become affected in a greater degree by each contraction or expansion of the pupils; the illumination of the foveal regions must become thereby only slightly altered, if at all. We have seen that the foveal positive after-form can be revived, either directly or indirectly, by directing the eyes to a white or to a black surface, or by changing the illumination in any other way. An idol-worshiper who has stood in awe of his idol for a long time, might later change the illumination of the retinas properly to revive a positive after-form of his god by looking at a wall, at a cloud, into an open fire-place, or perhaps into a dark well.

C. Cutaneous Ghosts

When we turn to the field of cutaneous sensations, we find positive after-patterns which follow fundamentally the same laws of behaviour as do the visual positive after-images. Periodically recurring cutaneous positive after-effects which appear and disappear in a similar way as do the visual positive ones, are quite frequently observed.[14] We shall discuss as briefly as possible the results of some detailed experiments in this field, and shall attempt to make clear the purpose for so doing by returning occasionally to the visual phenomena.

The subject laid his arm on a table and closed his eyes while I lightly stimulated the fore-arm with a compass-point, the immediate end of which was a nail head with a diameter of 1.6 mm. When this was held at a single place for a long time, the subject made the following verbal responses: "One point," after about twenty-five seconds: "None," after about five seconds: "One," and so on. The periodicity of the recurrence varied with the different subjects, and also with the same individual from time to time. The verbal responses which expressed the periodicity of recurrence, varied for each portion of the arm that was stimulated. As soon as the single nail was one time no longer felt, I applied the second nail of the compass to the skin at a distance of about six centimeters from the original point. The verbal responses heard were: "One, and you shifted it," after three or four seconds: "Two." Then I removed the first point and the subject made no response, so I asked how many points were present, and the reply was: "Two," and immediately: "Now it's only one." Even in this rough experiment, I finally found myself able to predict with considerable certainty at what times the subject would say two points when only a single one was being applied.

Then on the other fore-arm, I applied the two compass points simultaneously for twenty seconds, made a pause of twenty seconds, then again stimulated the same points for the same period, and so on. Finally it was necessary for me to stimulate only one of these points in order to cause both to respond simultaneously and positively. The reaction time of this cutaneous ghost, i. e., the reaction time of the induced response, was apparently no greater than that of the directly produced one, and no instrument has measured this: in all probability it is so very short, that until the contrary

[14] See, for example, Langfeld and Allport, An Elementary Laboratory Course in Psychology, Exp. 19, p. 32.

is proved, we may say it approaches the zero value.[15] (The reaction time of the verbal responses we shall not consider, merely because we have not chosen to discuss verbal ghosts.)

In the last experiment, I applied, after the systematic training, a single nail head, and the subject felt two, but the distance between the two responding areas was seldom accurately estimated; it was generally underestimated, and sometimes the points were judged to be almost together, when the real distance was 5 cm. I applied also the second nail head at a distance of 1 cm. from the first one; and the subject responded just as if the second stimulus had not been applied. This experiment indicates that the presence of the two objective stimuli within the 'Weber's circle' has caused investigators to assert that the individual can be trained to detect their presence there. But the simple fact that a single stimulus is often as good as two, indicates that the threshold does not become reduced as has been supposed.

In order to establish a reaction time for the cutaneous ghost, I chose a decidedly new area on the arm, and applied only one compass point for ten seconds, and then both simultaneously for ten seconds, before I made the regular pause of twenty seconds. I soon found that when I stimulated the first area only, it responded alone for about ten seconds, and then the other area responded suddenly so strongly that, when the second compass point was applied to it, this was a superfluous stimulus for the second area; the area was already responding as if to this stimulus. In this case, the reaction time of the ghost was about ten seconds. This was really a pseudo-reaction time to the stimulus used; the real reaction time was that time which lapsed between the presentation of the stimulus and the occurrence of the most immediately produced response. The second area now responded, not only when it was directly stimulated, but also when the first area became alone directly affected. We must then call the indirectly produced response a cutaneous habit, because it now occurs more frequently than originally. The usual frequency of occurrence is due to the fact that a greater number of the stimuli of the environment produce it, either directly or indirectly. Any response which is produced only directly by a stimulus is an instinctive one.[16]

[15] See my article on 'The Term Reaction Time Re-defined,' which has been accepted for publication by this journal, but which has not yet appeared.

[16] For a more detailed discussion of the problems of instinct and habit, see my articles: Ueber einfache Bewegungsinstinkte und deren künstlichen Beeinflussung; Zeitschrift für Sinnesphysiologie, 1915, and in connection with this, the one on Ubereinandergelagerte Rhythmen bei dem Menschen, in the same journal. 1916.

Fundamentally the same training method can be employed to develop the traditional paradoxical warm- and cold-spots. I stimulated one normal warm-spot with a heated nail head, and at the same time, I applied an ice cold nail to a normal cold-spot for twenty seconds. I then made the usual recuperation pause of twenty seconds, and so on, for an hour. At the close of the period, I found that when I adequately stimulated only one of these spots, the subject frequently judged both to be present. When I asked how far apart they seemed to be, the reply was: "They are almost together." The spots which were stimulated in the training, were in many cases, separated by a distance of about eight centimeters. At another sitting, I stimulated two spots of similar nature alternately, and at the end of the period the subject frequently responded, "Cold," when only the warm-spot was being stimulated. Likewise, the verbal response was often, "Warm," when only the cold-spot was being adequately stimulated. It is interesting that both of these sensations, even more so than the simple cutaneous ones, usually seemed to originate from about the same place on the skin. I later trained two spots in the same way, but by using one cold nail head and one which was at about the same temperature as the skin area of the subject. After the training, the subject reported, "Cold," when only the ordinary cutaneous stimulus was presented to its original spot. This is a paradoxical cold spot produced in the training by using an ordinary cutaneous stimulus and one in which the quality of coldness was emphasized. The cold-response was a negative cutaneous response or a negative cutaneous ghost. The cold-response was the habitual one, the directly produced one was the instinctive one.

We must not forget that we can speak in the same sense of visual instincts and habits. Apparently, in the absence of eye movements, the star gazer may see two or more stars when only one is in the field of vision. According to the results of our cutaneous experiments, we should expect that if the retinas are stimulated by a pattern of stars, this pattern may later be partially or wholly revived when only one of the previously stimulated retinal areas becomes affected by a single star. Also, when the person first directs the eyes to the single star, it might stimulate alternately two retinal areas. Then if the eyes remain still while only one of these areas becomes affected, we should expect a purely subjective or induced star corresponding to the other retinal area to appear and disappear. The observer would accordingly see two stars occasionally. We should expect the induced star

to be more transient than the one for which the objective conditions remain present.

Instead of a constellation of stars, I used a pattern of white spots which were round pieces of paper with the diameter of about 1 cm. I opened the door of the dark-room so widely that everything in the room could be distinctly seen. The observer then carefully fixated two spots, one centrally and one peripherally. These papers were pasted on a black cardboard and were separated by a distance of four centimeters. The distance of the observer's eyes from the spots was about one meter. After a few seconds of careful fixation, I closed the door; and, in the darkness, I placed a black cardboard over the peripheral spot without permitting the subject to know what change had been made. I then opened the door slightly, so that the remaining spot could be seen, and when this was carefully fixated, it was observed to periodically appear and disappear; and many subjects occasionally saw a ghost of the previously perceived peripheral spot. Then, in complete darkness, I uncovered the hidden paper and rotated the cardboard slightly so that the peripheral spot was displaced from its original position by about two centimeters. In the twilight, the observer fixated as usual, and three spots were occasionally seen simultaneously—the two for which the objective stimuli were present, and also the ghost of the previously observed paper. The results yielded by other similar experiments are fundamentally the same as those here reported, and correspond nicely with those obtained by experimenting with the unprotected surfaces of the body.

It may be of interest here to note that for the majority of the observers, the peripherally fixated spot disappears even more readily than the one which falls on the fovea. This occurs even when the eyes are exceedingly well dark-adapted. If, however, a circle of white spots is placed around the foveal one, the central spot, whether fixated foveally or peripherally, disappears, at least for some of the observers, much more frequently than any of those which form a part of the circle. It is often to be noticed that each of the spots induces itself in all directions. Between any two of the circles, the induced effects supplement each other and thus cause a more or less unbroken circle of white to be formed around the central spot. The relatively large area of black which surrounds the central white paper, induces itself in all directions; the white of the small area also induces itself in all directions; and finally there remains no line of demarkation between the spot and its background. When this occurs, we may say the white area dis-

appears. If the white is made larger, it will disappear eventually, but not as readily as when it is small. Of two unequal areas of qualitative sameness, the self-inductive effect of the larger one is greater than that of the smaller one; ard, consequently, the larger area does not become as strongly influenced by the self-induced effects of the background. Moreover, the more similar two areas are qualitatively, the more pronounced are the self-induced effects upon one another. It is for this reason that those investigators, who were interested in the absence of the rod processes in the foveal region, and performed their experiments in the twilight with just perceptible white areas, came to the conclusion that the fovea is a blind spot in twilight vision. A white spot, when carefully fixated in ordinary daylight, will disappear, but usually not as readily as in twilight where it is easily made qualitatively more similar to its large background.

The experiments thus far reported show clearly that there is really no fundamental difference between the behaviour of visual and cutaneous ghosts. It seems as if all forms of self-induction are fundamentally the same. Other more elaborate cutaneous experiments which follow, make the similarity between visual and cutaneous ghosts still more apparent.

Instead of the two points of the compass, 315 nail heads were used in training an area on the arm. At distances of 0.4 cm., holes were drilled in a 6.4 x 5.0 cm. block of wood, and the nails were driven into these in such a way that the surface of nail heads received the proper curvature to fit nicely over the arm of the subject. This block was placed on the arm and was allowed to remain for twenty seconds; after a pause of twenty seconds, it was again placed on the arm, and so on, for a period of thirty minutes. After a single half hour of such training, a single nail head of the compass was applied within the trained surface, and the subject reported: "Many, at least a half dozen." A week later, all the effects of the training had disappeared, and after three successive periods, thirty minutes each week, the effects began to persist from one period to another. We have in this case an indirectly produced positive pattern response which is fundamentally the same as any of our visual ghosts. In the case of the nails, the single nail which was applied and caused the pattern response to occur, is analogous to the insignificant illumination of the retinas which revived the elaborate visual pattern. Perhaps not all the 315 nail heads appeared in the revived

cutaneous pattern, and we are just as far from supposing that every single element of the previously perceived visual patterns appeared in the revived ones.

In my article on reaction time, which was previously mentioned, I made brief reference to an experiment similar to the one just described, the only difference being that a smooth surface of wood was used instead of the block of nail heads. After the smooth surface had been systematically applied to a surface of the body for a few days, it was found that a single point, preferably of the same material as that used in the training, so effectively revived the previously perceived cutaneous pattern that a second compass point was a superfluous stimulus when applied lightly within the trained area; the second point was not detected because at least the particular area to which it was applied was already responding as if to this stimulus. In our present experiment a second nail head was a superfluous stimulus when applied to many points within the trained area, because a large number of limited areas within the large one were already responding as if to so many nail heads.[17]

D. Kinaesthetic Ghosts

We shall conclude our ghost theory by discussing some forms of behaviour which are more tangible. A cockatoo moved its foot back and forth near its beak as if it were playing a Jew's-harp in the tempo of 0.21 seconds. I secured a Jew's-harp and played a monotone on it by moving my right hand in the same tempo in which the cockatoo moved its foot. At first the bird would not play with me, but I kept on playing to it occasionally; and finally, for some reason unknown to

[17] After these experiments on cutaneous sensations were completed, my attention was called to the following interesting, but purely theoretical statement made by William James, Psychology, II, p. 158: "When any point of the sensitive surface has been frequently excited simultaneously with, or immediately before or after, other points, and afterwards comes to be excited alone, there will be a tendency for its perceptive nerve-centre to irradiate into the nerve-centres of the other points." I wish to restate that part of this law which is of primary interest to us as follows: When any point of the sensitive surface has been frequently excited simultaneously with, or immediately before, other points, and afterwards comes to be excited alone in the same way as previously, there will be a tendency for the other points to respond simultaneously with or immediately after this one. It has been reported that a few people can recite, e.g., the ABC's from Z to A as readily as from A to Z without having the special Z to A training, but at no time have I observed such a duplicity of the association in my many human and animal subjects.

me, it began beating in the air with its foot. I ceased playing, but the bird played on. It played a group which contained sixty-one elements (a 61-group), and when it ceased moving its foot, I disturbed it for about a minute by shaking its perch, so that it could not play during the time; it had to clinch the perch fast with both feet to avoid falling. After this pause for the activity in question, I occasionally played the harp, and whenever the cockatoo started playing with me and played the 61-group, I shook the perch for a minute. Instead of bringing about a pause for this unitary act by shaking the perch, I could just as well have fed the beast. Whenever it played anything other than the 61-group, I left the bird unmolested, and it often played again after a short intermission. When it sooner or later played the 61-group, I shook the perch, and only after about three weeks of such training, I found that almost every time I entered the cockatoo's room and started playing the harp, the bird would follow, and in its silent way play the 61-group. I soon found that a minute was an unnecessarily long pause—from thirty to forty seconds sufficed. When I played the harp sooner than thirty or forty seconds after the cockatoo finished the 61-group, it would make either no noticeable response to my music, or, play some other group. Since I did not desire to establish any more than the 61-habit-group, I took special care to make long pauses.

The stimulus which originally started the 61-group was unknown—we shall call it 'X.' The stimulus which later produced the 61-group indirectly was my activity of playing the Jew's-harp—we shall call it 'J.' J produced simultaneously auditory- and visual-responses which were followed by the discontinuous kinesthetic-response, which was the 61-group. We shall assume that X was followed immediately by the 61-group; in other words we shall assume that X was the most adequate stimulus for the initial element of this unitary act. Whenever the 61-group was the direct response to the stimulus X, we may call it an instinct, the elements of which occurred in a constant tempo, a constant direction, and in a relatively constant amplitude of movement, thus making it a unitary group or act. The elements of the group were so many conditioned reflexes; the first was conditioned by X, the second by the first, the third by the second, and so on to the end of the innately associated series. Only those reflexes which are similar to one another are innately associated to form unitary groups of reflexes. Instead of speaking here of association, we might speak of induction, and accordingly say the ne ·ous

correlate of the first reflex of the unitary group was more similar in its chemical makeup to that of the second than to that of the third reflex and consequently induced action in the second structure; and for the same reason, the second then induced action in the third instead of the fourth structure, and so on to the end of the series of the inherently similar structures.

It would certainly be remarkable if X was of such a simple nature that it, when applied to the bird, caused a single reflex, but to avoid argument, let us suppose that this was the case: it makes really little difference what we suppose the very first reflex is like. The structure for the first reflex responded; this structure was similar in various degrees to others and accordingly induced action not merely in a single one, but in a number of others which in turn induced action in their next most similar ones, and so on. We accordingly get a number of qualitatively similar but quantitatively different (occasionally, however, quantitatively the same) groups marching along in the same tempo, and terminating at different intervals. Moreover, new groups may start at any time, e. g., the twentieth structure element or group of simultaneously occurring elements may induce action in the initial element of a new group which none of the preceding elements were capable of phasing. Kymograph records of well trained animals show that groups really do run in just such a temporally superimposed order; and these records also show us that when a certain number of these groups run their natural or innately determined courses simultaneously, many, and in cases apparently all of the remaining ones cease. If some of them continue, the beating member begins to move in a slightly different way, perhaps in a different direction, tempo, or general amplitude of movement; and, without waiting for a pause, we accordingly begin to count a new group which continues until a certain number of these cease simultaneously. Since such qualitatively similar groups begin and terminate at such irregular intervals, and since all of them are expressed by the same beating member, it becomes clear, for this if for no other reason, why the amplitude of movement of a given member always varies—even though the fluctuations may be slight—while the tempo and direction of movement may remain extremely constant for a considerable time.

Even in such a simple case as the one just discussed, we by no means observe a simple unitary group, but a great number of qualitatively similar ones which might be produced simultaneously by a properly designed pattern of stimuli. If

in the case of the 61-group such a thinkable pattern should be presented, all the groups that have concerned us would start simultaneously; and, the general amplitude of movement must necessarily become less as the quantitatively different groups terminate one after another and occasionally several at the same time. Such a phenomenon of fatigue, we observe in the field of visual sensations when the retinas become affected for only a few seconds with an intense visual stimulus. If the psychical state produced is one of whitishness, it becomes gradually less and less distinct.

We have supposed that the primary effect of the stimulus X is the first reflex, i. e., the first beat the bird executed, and the remaining sixty beats then compose the positive after-effect or the kinaesthetic instinctive ghost. Now, if we can revive the entire 61-group by using some stimulus other than X, we may speak also of the kinaesthetic habitual ghost. The stimulus J serves this purpose. We may now speak more generally and say the macro-61-group is a kinaesthetic pattern conditioned by micro-visual and auditory groups. As is the case with the visual and cutaneous ghosts, we also find it impossible to produce the kinaesthetic one while the structure correlates are in a state of exhaustion; we must in all cases wait until an adequate recuperation pause for the structures has elapsed.

Our reasoning concerning the innate associations of reflexes would lead us to suppose that when the 61-group became a habit, by virtue of the fact that it became associated with at least one other group that appeared frequently, the structure correlate of its first element and that of the last element of the conditioning group became chemically more similar than originally. Without stopping in this paper to discuss a theory of how this might take place, I shall dismiss the subject for the present by merely suggesting that, if the structure correlate of the first element of the 61-group is stimulated to function while the last element of the micro-group (in this particular case a micro-group) is still in a state of dissimilation, a part of the former may become included in the latter substance.

PSYCHOLOGICAL TESTS FOR THE AUTHORSHIP OF THE BOOK OF MORMON

WALTER FRANKLIN PRINCE, Ph.D.

The application of rigorous psychological tests to the mind of a man long since dead has its interest, and if thereby light is thrown upon a question of perennial debate, it achieves practical importance. The man to whom such tests will be here applied is Joseph Smith, the founder of Mormonism, who was killed in 1844, and the question which will be illumined is that of the authorship of the Book of Mormon.

There are three theories as to the origin of that book.

(1) It is a translation of the gist of records made by a succession of scribes of peoples anciently inhabiting America. This is the belief of several hundred thousand persons who find in the book the chief distinctive source of their religion. Since the odd contents of the volume lamentably or ludicrously fall before every canon of historical criticism, scholars have not thought it worth while to discuss the notion of its ancient authorship, unless briefly for pragmatic and missionary purposes.

(2) It was in the main written by Rev. Solomon Spaulding, who died in 1816, as a romance, but some religious matter was added by Joseph Smith, solely or with the assistance of Sidney Rigdon. This has been the prevailing view outside the ranks of its religious devotees, since about 1830.

(3) It was solely or essentially the work of Joseph Smith himself. This is maintained by a few scholars, mostly within the last 15 years. Prolonged analysis and comparison by the present writer make it incredible that Spaulding had any connection with the book, doubtful that Rigdon was implicated, certain that Joseph Smith's hand is perceptible in every part, and probable that he was the sole author, the edifice of whose imagination echoed to reminiscences which he was far from recognizing.

Three propositions may firmly be laid down, the evidence for which has never adequately been set forth, and, except for a part of that under the third head, finds no place here.

(A) If there were no knowledge of Joseph Smith what-

ever, or of the date when the Book of Mormon was copyrighted, it would nevertheless appear, from the numerous reflections of the times which it contains, that it was written somewhere between 1820 and 1834. Many passages certainly could not antedate 1826. With what we know about Smith and the copyrighting of the book, we are able to narrow down to the period between 1826 and 1829, with emphasis upon the year 1827. (Spaulding died in 1816.)

(B) If there were no knowledge of Smith, it would yet be most probable that the author lived in western New York. (Smith did, but Spaulding and Rigdon did not.)

(C) Having in possession our meagre knowledge of Joseph Smith's early career, and of his mental traits, all the assignable data in the Book of Mormon point to him and him alone as the author. For example, several of the dreams and visions contained in the book are incontestably slightly altered versions of dreams experienced by his father, which we find guilelessly related long after the prophet's death, in his mother's reminiscences.[1]

The tests which we are to apply are concerned mainly with the proper names in the Book of Mormon. The principle upon which they rest is found in the influence which memory-and-emotion complexes exert upon the invention of combinations of consonantal and vowel sounds. If a man is spinning a tale of fiction and manufacturing therefor quaint personal and geographical names, it is not the case that one combination of sounds will enjoy an equal chance with another of emerging in his consciousness. On the contrary, a combination resembling what may be called a master-word associated with some oft-repeated or strongly emotional experience of his past life will be much more likely to offer itself to his mind than any combination not so associated. For instance, if he has formerly been bitterly injured by a woman named Caroline, or else fondly loved one of that name, so that it is deeply imbedded in his memory and invested with strong feeling, it is many more times as likely that a combination beginning with "Car" will present itself to his mental view than that the immune syllable *bar, dar,* or *far,* etc., will do so.

[1] After tracing these passages in the Book of Mormon to their unmistakeable archetypes in Lucy Smith's story, I found that this had already been in part done by I. Woodbridge Riley, in his excellent "Founder of Mormonism," printed in 1902.

An honest elder of the Reorganized Mormon Church, to whom the "deadly parallels" were pointed out, could not deny that they existed, but suggested that the elder Smith might have had dreams prophetically forestalling the discovery and translation of the "Golden Plates"!

In fact, the whole name "Caroline" will tend to suggest itself. But then, if the authorship of the fiction, or the fact that it is fiction, is to be concealed, the too tell-tale word, emerging into the upper consciousness, will be rejected. But if it comes up, as it will then tend to do, in an altered and disguised form, as *Carlin,* or *Carowin,* and is not recognized, it is likely to please the unwary consciousness, as by a thrill, and be accepted.[2] If the inventor of names is of a strongly emotional and imaginative type, and especially if he approach the abnormal in this respect, the tendency will be pronounced. Since it is certain at least that Joseph Smith was responsible for the incorporation of his father's dreams into the Book of Mormon, it is not premature to remark that he was thus characterized.[3] At any rate, the author of that book was, as will be shown, demonstrably subject to the tendency, which will betray, as we proceed, first that he probably lived, like Joseph Smith, in western New York, secondly that he invented many of the names within three or four years before Joseph Smith offered the book for copyrighting, and thirdly that he was either Joseph Smith himself or a man many of whose personal antecedents and relationships duplicated those of Joseph Smith to a degree unheard-of and incredible.

Entering upon our thesis, it is first necessary to set forth one of many reflections in the Book of Mormon of the times in which it was written, since the emotional accompaniment in the mind of the author furnished the soil out of which a throng of the invented proper names grew. I refer to the Anti-Masonic excitement which began with the abduction of William Morgan in 1826. This man had announced that he was about to publish a full account of the secret rites and alleged tendencies of Masonry, and having been arrested in Batavia, New York, on a charge of theft, was taken to Canandaigua and there acquitted, rearrested for debt and lodged in jail, and thence taken to the Canada line where all traces of him finally disappeared. The agents in these acts appear to have been Masons. The popular excitement roused, beginning in western New York, was prodigious. The feeling first in

[2] If the fiction, and consequently the names, should be a semi-conscious or subconscious and automatic construction, as may very possibly have been the case with the Book of Mormon, the mechanism involved would not be dissimilar to that stated. The associational and emotional processes would still govern, and identical names which would constitute a "give-away" would be rejected by the inner "psychic censor," to adopt a Freudian term, while slightly disguised ones might pass its inspection.

[3] See Riley, "Founder of Mormonism."

western New York crystallized into a political movement which spread more or less over the whole country as the Anti-Masonic Party. The movement rapidly subsided, and even in New York the party ceased to be a positive factor in 1833, but feeling still continued to be strong in the western part of the State, where Smith lived.[4] The Morgan pamphlet was printed after his disappearance, and we shall presently see that the writer of the Book of Mormon was familiar with it.[5]

Now in at least twenty-one chapters in seven out of the sixteen "books" of the Book of Mormon are to be found passages, varying from several to sixty-three lines in length, plainly referring to Masonry under the guise of pretended similar organizations in ancient America. The warning of Washington in his Farewell Address, against "*combinations . . . with real design to direct, control, counteract or awe the regular deliberation and action of the constituted authorities*" was quoted a thousand times in Anti-Masonic speeches and writings, and accordingly we find the Book of Mormon employing the term "*combination*" five times in its descriptions of the alleged ancient societies, and "*secret combinations*" fifteen times. Thrice it boldly names them "*secret societies*," while "*secret works*," "*secret abominations*," "*secret plan*," "*secret signs*," "*secret band*," "*secret oath*," and "*secret words*" are employed *ad nauseam*. The claim or poetic fiction of the Masons that their order is from very old times is reflected in "which had been handed down from Cain."[6] "They did have their . . . secret signs and their secret words, and this that they might distinguish a brother"[7] has a familiar sound, even to the word "brother." Once the word "craft"[8] is employed in this connection, not only a word in technical use by the Masons but also found on the title-page of the Morgan pamphlet. No charge was

[4] "Life of Wm. H. Seward" by E. E. Hale, Jr., pp. 69, 71, 104. See also "W. H. Seward" by T. K. Lothrop, pp. 15-16; "Horace Greeley" by James Parton, pp. 101-102; MacMaster's "United States," vol. V; "Roberts' "History of New York," pp. 580-581; contemporary pamphlets and periodicals.

[5] The essential part of the title-page reads thus: "Morgan's Masonry exposed and explained, showing the origin, history and nature of Masonry, its effect upon government and the Christian religion, and containing a key to all the degrees of Masonry . . . the whole intended as a guide to the craft and a light to the unenlightened." By Captain William Morgan.

[6] Book of Mormon, Ether 8:15. All references to the B. of M. are to the Utah edition of 1908.

[7] B. of M., Helaman 6:22.

[8] B. of M., Helaman 2:4.

more frequently sounded in the furor of 1826-33 than that the Masons monopolized the offices, and defeated justice in the courts in the interest of their members, and accordingly we read in the Book of Mormon of the "secret combinations" "filling the judgment-seats, having usurped the power and authority of the land . . . letting the wicked go unpunished because of their money, and moreover to be held in office at the hand of government, to rule and do according to their wills, that they might get gain and glory of the world; and moreover that they might the more easy commit adultery, and steal, and kill, according to their own wills."[9] Innumerable papers and pamphlets declared that Masonry was subversive of freedom and popular government (and this is intimated on the title-page of the Morgan pamphlet), and so the supposedly ancient record sagaciously speaks of "this secret combination which *shall* be among you" and warns that "whosoever buildeth it up seeketh to overthrow the freedom of all lands."[10] As Masonry was charged with being inimical to religion (and this also is intimated on the title-page of the Morgan pamphlet), so we find the replica "They did reject all the words of the prophets, because of their secret society and wicked abominations."[11] But, more pointedly, not only are the general charges against the Masons faithfully impressed upon these many passages of pretended ancient date, but so also is the tragedy of William Morgan. Twenty-eight times, and in almost every passage, are the "secret combinations" coupled with "murder" and "murderers," while the words "kill," "slay" and "blood," with similar implications, are employed. The source of the obsessing idea becomes more patent with the four-fold use of the expression "secret murder,"[12] since Morgan was murdered secretly if at all. Even the killing of a Book of Mormon character in "a secret pass" is probably a reflection of the belief that Morgan was drowned in the clandestine *passage* from the United States to Canada. At any rate, it is impossible to mistake the connection between the belief of the masses that the light sentences of the several men convicted of Morgan's abduction was an insult to justice and the statement in the Book of Mormon that lawyers and others connected with the ancient covenants conspired to "deliver those who were

[9] B. of M., Helaman 7:4-5.
[10] B. of M., Ether 8:24-25.
[11] B. of M., Ether 11:22.
[12] B. of M., Alma 37:22; Helaman 8:4; Helaman 6:29; 3 Nephi 5:5.

guilty of murder from the grasp of justice."[13] And parallels continue. It was charged that Morgan was practically condemned in a secret session of a lodge, and as a matter of course the pretended record declares it the case in ancient America that "whosoever of those who belonged to their band who should reveal unto the world of their wickedness and their abominations should be tried not by the laws of their country but by the laws of their wickedness."[14] Here is a double parallel, for the illegal condemnation in both cases was for exposing the secrets of the order. But as the modern crime was in vain, since the Morgan pamphlet was published nevertheless, so in the Book of Mormon we hear the exultant cry, "Their secret abominations have been brought out of darkness and made known unto us."[15] To fairly cap the climax, the widow and babies whom Morgan left finds her parallel in the "widows"[16] and "orphans" of the Book of Mormon, made such by "secret abominations"; and the fact that the murderers of Morgan (if he was indeed murdered) never were punished, is reflected in the sentence, forming part of a paragraph about the ancient "combinations," "The Lord will not suffer that the blood of his saints [!] which shall be shed by them shall always cry unto him from the ground for vengeance upon them."[17]

And now we plunge into *medias res*. It is now sufficiently evident that the author of the Book of Mormon was, at the time he was writing it, powerfully obsessed by the ideas and emotions which characterized that popular movement which, beginning in western New York in 1826, was to subside last in the same region. What word would sink most indelibly into such a consciousness—what but the name MORGAN itself? Over and over again, as the writer sought a name for a new character or locality, the name Morgan would present itself. But this telltale name would be rejected, by the upper intelligence if the work was conscious fiction, by the "psychic censor" if it was "an automatic product." But when the word came up in a disguised shape, the first syllable "*Mor*" intact, the letter "m" either elided or substituted, a vowel either the same as the second vowel of the obsessing name or similar to it in common utterance, the identical letter "*n*" following, with or without additions, an unsophisticated upper intelli-

[13] B. of M., 3 Nephi 6:29.
[14] B. of M., Helaman 6:24.
[15] B. of M., Alma 37:26.
[16] B. of M., Mormon 8:40.
[17] B. of M., Ether 8:22.

gence or subliminal "psychic censor" would not perceive its betraying quality, and it would be written down. Now in the book which we are inspecting there are not fewer than twenty-five words which begin with the syllable "*Mor,*" and every one of them is presently followed by the letter "*n,*" with either the identical vowel "*a*" preceding it, or the vowel "*o*" (and in popular speech the pronunciation of *o* in *Mormon* and of *a* in *Morgan,* are practically identical, being quite or nearly equivalent to the short sound of *u*). Also, precisely as "Morgan" is the masterword of the particular ideational and emotional complex of which we have been speaking, so *Mormon,* one of the reflected names, is the chief character of the composition, while "*Mormon*" is also the name of the composition as a whole. The entire list follows.

MORmoN (Lamanite king)
MORmoN (son of the above)
MORmoN (Nephite prophet)
MORmoN (name of entire book)
MORmoN (division in Book of Mormon)
MORmoN (name of a forest
MORmoN (land of)
MORmoN (place)
MORmoN (body of water)
MORmoN, Words of (division in Book of Mormon)
MORoN (Jaredite king)
MORoN (land of)
MORoNi (Nephite prophet)
MORoNi (last Nephite)
MORoNi (division of Book of Mormon)
MORoNi (city)
MORoNi (land of)
MORoNihah (Nephite general)
MORoNihah (another Nephite general)
MORoNihah (city)
MORiaNton (founder of city)
MORiaNton (Jaredite king)
MORiaNton (land of)
MORiaNton (land of)
MORiaNtom (land of)
MORiaNcumr (place)

Now, while the fact that out of the 40 proper names in the Book of Mormon having the initial letter M, 25 begin with the syllable *Mor,* and the fact that every one of these 25 further contains or approximates the final two letters of the obsessing name "Morgan," are impressive, it is not expected that they will be convincing by themselves. The demonstration is but begun. And right here we add that there are at least two other reflections from the same name (making a sum of 27), namely:

AmMORoN (Nephite apostate), and aMORoN (Nephite officer).[18]

For some time I stupidly wondered why the writer made

[18] It is worth considering whether the wraith of *Morgan,* appearing in Ammoron, has not brought along with it the echo of the last syllable of *William.* Compare

williAMMORgaN and
AMMOR oN

so many of his proper names begin with the syllables *"Anti,"* suspiciously identical with the *Latin* prefix. But suddenly it dawned upon me. What word connected with the excitement of 1826-33, rivalled "Morgan" as a tocsin-call to the emotions? Manifestly, "ANTI-MASONIC," the name of the political party which Morgan's abduction roused into being. Consequently, we find the distinct reflex of the prefix in 14 proper names of the Book of Mormon:

ANTInephilehi (a people)
ANTInephilehi (Lamanite king)
ANTIomno (Lamanite king)
ANTIonah (a ruler)
ANTIonum (Nephite general)
ANTIonum (land of)
ANTIparah (city)
ANTIpas (mountain)
ANTIpus (Nephite commander)
aniANTI (village)
mANTI (person)
mANTI (city)
mANTI (land of)
mANTI (hill)

The obsessing prefix clamored incessantly for deliverance, and achieved it, but not perfectly, in 14 other instances:

archeANTus (Nephite officer)
coriANTon (son of Alma)
coriANTor (father of Ether)
coriANTum (Jaredite king)
coriANTum (Jaredite prince)
coriANTum (Jaredite captive)
coriANTumr (Lamanite general)
coriANTumr (last of Lamanites)
ANTum (land of)
gadiANTon (a robber chief)
irreANTum (body of water)
moriANTon (land of)
moriANTum (land of)
seANTum (a nephite)

But why should not the latter member of the term "Anti-Masonic" be reflected among the names in the Book of Mormon, as well as the former? So the reader may ask, and so the writer asked, and looked, and behold it was, in

MAthONI and MAthONIhah

Just lisp the sibilant and you have the entire word "Mason" and almost the entire word "Masonic" in both of these appellations. Does this only happen so? Then why does there not happen to be in the list a single Bathon, Cathon, Dathon, Fathon, Gathon, Hathon, Jathon, Kathon, Lathon, Nathon, Pathon, Rathon, Sathon, Tathon, Vathon, Wathon, or Zathon? Not one of these is more unlikely in itself than certain names which do occur, as "Zeezrom." But it is precisely "Mathon" which we find, and two of them at that.

This brings us to a resembling group of odd names.

Zeezrom (a corrupt lawyer)
Zeezrom (a city)
Cezorum (leader or tool of robbers)
Seezorum (judge elected by robber band)

Each of these names commences with the soft or hard sibilant, each is followed by sounds which may be variously spelled

"eez," "ez," or "ese," and each continues with "ro" or the same letters reversed in order. It seemed to the present writer that they also must have risen from some obsessing word which persisted in offering itself, and was accepted four times when slightly disguised. Among the names of the men arrested for Morgan's abduction I found that of one Chesebro. This name resembles those of the above group in several particulars. The initial sound is that which most resembles the sibilant. The combination "ese" is the phonetic equivalent of "eez" and "ez." And, disregarding the "b," "*ro*" is found in two of the group, and in the other two in reversed order. Compare CHESEbRO and ZEEZROm.

But why should the name of this man have produced an emotional impression more than the names of the other three men convicted,—Lawson, Sawyer and Sheldon? For no reflections from the latter three can be found. Research disclosed that Chesebro was the principal actor and spokesman in the proceedings against Morgan up to the time that he was taken from the Canandaigua jail and hurried to the Canada line.[19] Chesebro was the man who obtained the warrant for Morgan's arrest on the charge of theft. Chesebro raised the posse that went to Batavia after him. Chesebro is almost the only one mentioned as speaker at the time of leaving Batavia, in the various affidavits. Chesebro had another legal paper ready so that when Morgan was acquitted in Canandaigua he was rearrested for debt and put in jail. Chesebro appears to have been behind the proceedings by which Morgan was delivered from jail and started on the way to Canada. Chesebro's sentence was lighter than that of Lawson, because he was to a degree sheltered by legal forms, and although Lawson had the most prominent part in the final journey, and Chesebro drops out, the later incidents remained in comparative obscurity. And let it be noted that Canandaigua is but nine miles from Manchester, the home of Joseph Smith, who if not there during a part of 1826, without question lived there after his marriage in January, 1827, when the excitement was at its height.

Finally, in this connection, the name Archeantus, already cited among those affected by the "Anti" prefix, probably reveals another relationship. It was charged that the actual drowning of Morgan was accomplished directly after the in-

[19] "William Morgan, or political Anti-Masonry," Rob. Morris. "Republican Advocate," Batavia, N. Y., issue of Sept. 29, 1826. "Narrative of the facts and circumstances relating to the kidnapping and presumed murder of William Morgan," Rochester, 1827.

stallation of a Royal *Arch* chapter, by persons who took part therein. Also that Morgan himself became a Royal *Arch* Mason a year or two before his supposed death. Thus we find *anti* and *arch* appropriately conjoined in "Archeantus."

Thus far, we have found the one Morgan-Antimasonic complex (the same which in after years subconsciously influenced Joseph Smith to call his fiscal institution, on the wildcat bills which it issued, an "*Anti*-Banking Company") influential in the production of 59 names out of the about 350 in the Book of Mormon, or more than a quarter of the whole list, aside from those either taken intact from the Bible (77) or transparent imitations of Biblical names (upwards of 50).[20]

As has been said, in spite of the abduction of Morgan his pamphlet, professing to disclose the ritual of the first three degrees of Masonry, was published. Later in the same year, 1827, someone followed it with a pamphlet revealing the ritual of the four next higher degrees. Still later the two pamphlets were issued as one, and are so reprinted to-day. Now the author of the Book of Mormon was familiar with the Morgan pamphlet but not with the other. The proof of this double assertion is found in the fact that in almost every case where, in the Morgan pamphlet, a word is capitalized or italicised because of its technical employment in the ritual, the word is found in a slightly disguised form among the proper names of the Book of Mormon, besides other reflections, while no such reflections from the second publication are discernible. Anyone can consult the reprint for himself, and test the truth of the following assertions.

We do not find "Tubal-Cain" (italicised on pages 55, 59, 69 and 80 of the Morgan pamphlet) in the Book of Mormon, but we do find TUBALoth.

We do not find "shibboleth" (italicised on pages 39, 40, 43, 45, 46, 49, 53 and 79), but we do find SHIBLom (two applications) and SHIBLon.

We do not find "Jachin" (capitalised on pages 43 and 79, and italicised on pages 43, 46 and 52), but we do find JACom and JAshoN.

We do find "Boaz" (capitalised on pages 21 and 79, and italicised on pages 31 and 52), since the fact that it is a Biblical name caused it to pass unaltered.

We do not find "Mahahbone" (capitalised on pages 80 and italicised on page 64), but we find MAHAH.

We do not find "Hiram Abiff" (italicised on page 61), but we find ABIsh.

[20] See "Dictionary of the Book of Mormon," Geo. Reynolds.

On page 52 of the Morgan pamphlet there is an allusion to the (mythical) Palestinian city of "Zaradatha." There are no italics this time to make this name stand out, but its own sonorous, mouth-filling magnitude was probably as effective, besides which the purported city is mentioned in the course of a paragraph which, as we shall see, for other reasons strongly impressed the writer of the pseudo-history. The chief city of the Book of Mormon is not called Zaradatha, but it is called ZARAhemlA,—the same first two syllables, the same termination, only three letters in the same total of nine altered, the same number of syllables. Who can doubt the relationship of the two artifects?

The two "Jonases" in the Mormon set of twelve disciples is probably reminiscent of the fact that the Masons dedicate their lodges to John the Baptist and John the Evangelist, as stated on page 39 of the Morgan pamphlet; and "Jonas" is suggestive of *Johns,* aside from there being two of the former.

An amusing instance, and one of the most significant, is the name "Isabel," one of the three feminine ones in the Book of Mormon. With the illiterate writer, indeed, there was nothing about this word to put either his upper consciousness or his interior "psychic censor" on guard. But to us the Old French and Spanish name Isabel is richly grotesque considered as that of a descendant of Israelitish stock living in America some 2,000 years ago. The source of its adoption is clear almost to demonstration. For reasons which cannot here be set down it appears that the writer was familiar with some book giving a meagre account of the first voyages to America and a very elementary description of the so-called civilizations found there, in Peru, Central America and Mexico. What woman was bound to be mentioned, far more prominently than any other if not exclusively? Manifestly Isabella, the Castilian queen who financed Columbus's memorable first voyage to America. The name Isabella, insistently knocking for admission through the avenue of the writer's mind into the Book of Mormon, would be rejected, but under the slight disguise of "Isabel" it effected entrance.[21]

[21] Isabel (B. of M., Alma 39:3-4) is represented as a harlot. This too may be a result of associative processes in a dreamily reminiscent mind: (1) The author was familiar with the ultra-Protestant view identifying the Roman Church with the "scarlet woman," and the "harlot" of the Revelation of St. John. (2) Isabella being a Roman Catholic, and the Spanish Inquisition having been founded during her and Ferdinand's reign, the concepts of the "scarlet woman" and of Isabella tend to coalesce; (3) the name Isabel successfully emerging in his mind, it draws after it the notion of harlotry.

Before parting with the Morgan pamphlet utterly, we may clinch its connection with the Mormon scripture by reference to several matters not concerned with proper names. In the latter is the curious incident of Lehi's finding at the door of his tent (1) a ball, (2) made of brass, (3) hollow, (4) having inside, (5) two spindles, (6) one of which persistently pointed the way that should be traveled.[22] A brass ball, with spindles *inside,* seems a curious sort of an arrangement for even a miraculous compass, neither is it evident from the narrative why there were *two* spindles. But turn to page 52 of the Morgan pamphlet and all is clear. There we find it declared (though the information is not authentic) that on each of the two great pillars in Solomon's Temple was (1) "a large globe or ball," that it was (2) of "brass," that it was (3) "hollow," and that (4) inside were (5) two sets of maps, one of the celestial, (6) the other of the terrestial bodies. We see now why the spindles of Lehi were inside the brass ball, this is a mere, unreasoning reminiscence of something being inside the pretended ball of the temple. And we see why there were two spindles, there were two sets of maps in the archetypal ball. One of the spindles was certainly a good substitute for terrestial maps, as it pointed exactly the way to go, while the other is reminiscent only, without its use being explained.

Again, Nephi, on a certain occasion, stretches forth his hand, and his brothers experience "*a shock.*"[23] We need only to cite that on page 27 of the Morgan pamphlet it is stated that at one stage of the opening of a lodge the members stamp and clap their hands at the same instant, and that this is called (italics in the original) "*the shock.*"

The exhibition thus far of the psychical mechanics involved in the invention of names for the Book of Mormon has been of interest, but has afforded only stray, though significant, indications that the writer was Joseph Smith.[24] Unfortunately

[22] B. of M., 1 Nephi 16:10.

[23] B. of M., 1 Nephi 17:53.

[24] There are many indications of a sort not pertinent to this paper of Smith's authorship. In fact Joseph can be seen at various intervals, walking through the volume. As the dreams of Lehi, father of Nephi, repeat the substance of the dreams of Joseph's father, so Nephi himself in his relations with his unbelieving as well as his believing brothers, probably stands for Joseph and his brothers with their differing views regarding his early claims. Over and over again passages reflect the known environment of Joseph Smith. Facts personal to Joseph are found. For example, he is known to have practiced "crystal-gazing," and in the Book of Mormon more than one mention of a transparent stone which revealed hidden facts, is to be found. To all but believers in the authenticity of the book as a record of ancient American peoples,

our knowledge of his early experiences of strongly emotional cast is but scanty. But we do know that he was forming an attachment for a certain girl in 1825, and that he married her Jan. 18, 1827. Since the book in question contains scattered throughout it passages and names which reflect the Anti-Masonic excitement, it could hardly have got on very far before 1826, and it must have been finished by 1829, for in that year it was copyrighted. The period of Smith's courtship and early married life corresponds, then, pretty closely with the period when the Book of Mormon was writing. Since no name is more vividly engraved on the mind of a young man than that of the girl of whom he is enamored, if Joseph Smith wrote the book and if our thesis in regard to the influence of emotional complexes upon its proper names is correct, we ought to be able to find the first name of his sweetheart, Emma, and very likely the last name also, Hale, in penetrable disguise. We do not find "Emma," nor would we expect to do so, for the "psychic censor" above or below the threshold would not let it pass. But we do find both "*Emer*" and "*Ammah*," the two proximate substitutes. We do not find "Hale," though that must have clamored for emergence, but it repeatedly succeeded in securing adoption unrecognised by the device of exchanging the vowels. Thus we have

HELAm	(Separate and	HELAman
HELAm	distinct persons	HELAman
HELAm	and places)	HELAman
		HELAman

If these correspondences are accidental, it ought to be as easy to find correspondences in the cases of names hit upon haphazard, or taken *en masse*. For example, I will produce the names of all my living near and feminine blood-relatives (not to make the list too long), and anyone interested may compare them for himself, if he will take the trouble, with the list of names in the Book of Mormon. First names: Elmira, Louise, Clara, Ella, Cora, Imogen, Maude, Nellie, Mabel. Last names: Prince, Blackman, Graves. There is one slight resemblance that of Louise to Luram and one stronger one, that of Cora to a group of names beginning

with all its glaring departures from historical possibilities, the prediction that there would arise a seer who should be Joseph Junior and do various things that the actual Joseph Junior professed to have done, and the prediction of a peculiar accident which happened in the course of the "translation" of the Golden Plates causing Joseph considerable discomfort, point to him as author.

"Cor—." But of course out of a considerable number of names taken at random or *en masse* occasional accidental resemblances are bound to occur. It is where we are able to go to the spot and say, if this principle which we appear to have discovered is really valid, such a name should find a resemblance, and the predicted result over and over again follows, that the correspondences are convincing. We happen upon accidental occurrences now and then, but science, the knowledge of governing law, foretells occurrences and where they shall be looked for. Take the population of the earth and you will occasionally find a man who paints a turtle as a symbol in some way personal to himself, but ethnological science says, if that particular man belongs to such an Indian tribe he certainly paints a turtle upon his cheek, as the totem-mark of his nativity. Moreover the list of my female relatives did not disclose accidental resemblances between both first and last names of a single individual and Mormon names, whereas both Emma and Hale find their correspondences, as was most unlikely to occur by chance, but almost certain by operation of the psychological law which has been explained.

Again, one would naturally predict that if any of the numerous towns which Joseph Smith lived in prior to 1826 were to be found reflected in the names of the Book of Mormon, Sharon where he was born, and Manchester which was his residence from his 13th to his 20th year, and again after his marriage, would be the ones, rather than those which boasted of him for short periods between the time of his birth and his 13th year. And we do find SiRON, and

MANti (Nephite spy)
MANti (city)
MANti (land)
MANti (hill)

also four HelaMANs
and six LaMANs.

One may object that the Mantis have been already accounted for by the obsessing "Anti." This is true, but the two derivations do not exclude each other, but on the contrary furnish a good example of the processes involved. Having got as far as the *Man* suggested by the name of his own town, the reminiscent consciousness of Smith found itself already in the *anti* groove, and completed the short journey.

It appeared to the present writer, by this time, almost certain that the name Harmony, that of the town where Joseph Smith spent so many happy, loving hours courting Emma, would be discernible, so he again consulted the list and found HiMNI. I need not point out the radical resemblance. Is

that resemblance accidental, and not due at all to the haunting cadences of that doubly-blessed name "Harmony?" Let us again test the theory of accident by my own relatives, who certainly had no part in the authorship of the Book of Mormon. My father got his girl in Detroit; if there is any name in the Book of Mormon which strongly resembles Detroit it will certainly be an accident. The only two Mormon names beginning with D are David and Desolation. One of my uncles got his girl in Palmyra; there is nothing nearer than Pahoran. My other uncle got his girl in Pittsfield; there is nothing nearer than Pacumeni. My older brother got his girl in Moxie; Mocum is the nearest resemblance. I got my girl in Newport, which matches best with Nehor. My younger brother got his girl in Detroit, which finds only David and Desolation to be compared with. This is not a selected list, for I know not where another male relative got the partner of his joys and sorrows. But here are six cases in any one of which a decided resemblance *might* turn up by chance, over against one case where the decided resemblance was looked for in obedience to law. A shadowy resemblance or two may indeed be fancied between members of the group and names in the Book of Mormon, but surely nothing comparable with this

HarMoNY HiMNI

The two emotional experiences of which we know, in Joseph Smith's early life, were exceedingly fruitful of effects upon the invention of proper names in the strange book which must have been his composition. Were we informed of other such experiences, we could doubtless trace their effects also. One such, we are reasonably sure, existed, to account for the first two syllables in a group of names already casually referred to. This is the list.

Corianton (son of Alma)
Coriantor (father of Ether)
Coriantum (Jaredite king)
Coriantum (Jaredite prince)
Coriantum (Jaredite captive)
Coriantumr (Lamanite general)
Coriantume (last of the Jaredites)
Corihor (Jaredite prince)
Corihor (another Jaredite)
Corihor (land of)
Korihor (Nephite anti-Christ)

Here are eleven names in every one of which the first two syllables are pronounced exactly the same. If the author was, before he met Emma, we will say, in love with a girl named Cora, that might account for it. If a man named Corey was the center of a strongly emotional experience, that would account for it still better. We do not have the data to de-

termine what the experience was which set the combination "Cori—" so frequently knocking, though pretty certain that there was one.

Was there a discernible tendency to apply obsessing words, in disguised form, with discrimination, attaching those of agreeable association to persons conceived of as good, and those of disagreeable connotation to those regarded bad, in the Book of Mormon? It would seem so, the tendency apparently acting in dreamy fashion, and hence not always accurately. For example, Morgan was regarded as a martyr, dying for the sacred cause of light and liberty, hence to be considered as crowned with the pleasing halo of goodness. Of the eleven mythical persons whose names are reflections of his, eight appear to have been good and three bad. On the contrary, Chesebro, as the persecutor of Morgan, was regarded as a fierce, disagreeable personage. Accordingly Cezorum was a robber belonging to a "secret combination;" Seezorum was a corrupt judge, member of the same order; and Zeezrom was a wicked lawyer (note that Chesebro was the one of Morgan's abductors who sheltered himself under legal warrants) who withstood the servants of God. Emma and Hale were certainly names invested with agreeable associations, and all the characters, seven in number, whose names are reflections from one or the other of these, appear to be good. Harmony, as the place of Joseph's love-making, was surely one of charm, and we are prepared to find Himni an exemplary gentleman. At first it might appear that Mathoni and Mathonihah, since *Masonry* is so dreadful, should have been bad men, but then we remember that "Anti-Masonic" was the obsessing word, and Anti-Masonry was regarded as irreproachable.

There is also somewhat of a tendency in the names derived from a particular complex to group themselves together in the Book of Mormon narrative. For example, Ammoron is most prominent in connection with a correspondence between him and Moroni, and is killed in the city of Moroni, which is in the land of Moroni; while Amoron is mentioned only as the giver of certain information to Mormon. No attempt has been made to work out further groupings.

We have already seen that Joseph Smith in after years manifested one of the obsessions so visible in the Book of Mormon, when he gave his Kirtland fiscal institution the singular name, "Anti-Banking Company." Moroni is also one of the betraying names of the Book of Mormon, but it is outside of its covers that we are told of the resurrected

Moroni, who led the way to the Golden Plates. It is certainly the mouth of Joseph Smith now that utters the name of veiled significance in connection with his own alleged adventures. It is not in the Book of Mormon, but in one of those subsequent "revelations," which, if Deity did not compose them, Joseph Smith did, that Joseph is given a new name.[23] This name, Gazelam, is of double significance: first because it was applied in the Book of Mormon to a man who was given a stone in which to see hidden things, exactly as Joseph himself had been accustomed to seek for knowledge by means of a "peep-stone;" and secondly because the very word "Gazelam" contains unconcealed another word expressive of the process by which knowledge was thus sought.

And best of all, it is in one of Joseph Smith's "revelations" that we are informed that the name of a character unnamed in the Book of Mormon, and undesignated other than that he was "the brother of Jared," was really Mahonri Moriancumr. Now that we have the keys to his ruling complex, he might as well have written that the name was

MASONRY MORGAN.

[23] Smith's "revelations" likewise gave new names to some of his living associates, and to things. In some instances the mechanism so apparent in the Book of Mormon is discernible here, as when he renames Oliver (Cowdery) *Olihah*, and the tannery *tahhanes*. But in other cases there is no resemblance, probably because the "psychic censor," having the models so closely at hand, took alarm and rejected similar sound-combinations.

LABORATORY TESTS OF ANGER, FEAR AND SEX INTEREST

By Henry T. Moore, Dartmouth College

The following experiments were devised with a view to determining approximately by a simple behavioristic test an individual's liability to be disturbed by emotional stimuli of certain definite kinds. Stated briefly, the plan of procedure was to measure the effectiveness of emotional disturbance in terms of delay in the solution of a problem given just prior to the introduction of the emotional stimulus.

The problems given were mental multiplications of selected numbers between 64 and 99 by 4, 6, 7, 8 and 9. The various number combinations were made as nearly as possible of the same difficulty, and proved to be of a sort that required from five to fifteen seconds for the average student to solve correctly when left undisturbed. The average of the mean variations of fifteen subjects for four problems each under normal conditions was 4.2 sec., hence this kind of task seemed to be one in which variations of more than six or seven seconds in the time of solution were likely to indicate something more than the varying difficulty of the task itself. Whenever a considerable delay resulted from the application of a distracting stimulus, the amount of this delay would seem to be in some sense a measure of the amount of distraction. Since, however, the special concern was not with degrees of distraction, but with amounts of anger, fear, etc., it was necessary to eliminate as far as possible the effect of general distractibility in each case of emotional stimulus. For example, in attempting to determine the extent to which an individual was annoyed by an anger provoking stimulus, it was not possible to compare his time under provocation with his normal time, for the reason that he might be easily distracted by any kind of irrelevant stimulus, and yet not very irascible. To get at the specific anger effect it was necessary to compare his "anger time" with the average of all the "distraction times" taken together.

Twenty-two subjects were given twenty problems, during each of which some sort of emotional distraction was at-

tempted. The twenty problems were divided into five series of four problems each. The stimuli accompanying the first series were intended to provoke anger; those with the second series to provoke fear; with the third, sex interest; with the fourth, repulsion; with the fifth embarrassment in the presence of a crowd.

Anger Stimuli. These tests were meant to involve (1) anger at an unjust accusation, (2) anger at bodily annoyance at the hands of another person, (3) anger at having been prevented from carrying out the task called for.

The attempt to excite anger at an unjust accusation was made as follows. Before the subject was aware that the experiment proper had begun, the experimenter stopped and said,—" By the way, Mr. S. Before I forget about it, I think I ought to bring to your attention a letter which came to me to-day, and which I am sure contains an error on someone's part that you can set me right about." The experimenter then handed him a typewritten letter purporting to come from the offices of administration, and which read as follows: " I have just learned from the registrar that an examination proctor has filed a statement in which he expresses it as his opinion that Mr. S. was guilty of dishonesty in connection with one of the mid-year examinations. While the circumstances do not amount to proof, it is advised that all those instructors with whom Mr. S. is taking courses give especial attention to his methods of class-room work, with a view to determining what measures should be adopted in dealing with his case." After having allowed fifteen seconds for the reading of the letter, and having remarked that it might be better to leave the consideration of it until later, as someone had undoubtedly made a mistake, the subject was asked to solve the first problem. The difficulty with this particular stimulus is that not all of the subjects lend the same degree of credence to the letter.

Two tests of anger at bodily annoyance at the hands of another person were next in order. During the solution of one problem the experimenter had a third person draw his hand sharply upwards across the face of the subject, striking smartly the tip of his nose in passing. A similar test consisted in striking the subject sharply three times on the cheek during his effort to solve the problem.

A third type of provocation was that of having an assistant interfere in three successive efforts made by the subject. The interference consisted in saying aloud a series of numbers calculated to make it impossible for the subject to carry out

successfully his mental multiplication. After three such disturbances he was allowed to finish without interruption.

Fear Stimuli. Four types of fear stimulus were tried. They were devised with a view to bringing into play fear of snakes, of personal attack in the dark, of electrical shock, and of falling.

As a test of the disturbing effect of the fear of snakes, the subject was seated in the center of a room completely dark, and some reference was made to snakes. Immediately thereafter the problem was given him, and while he was attempting the solution, a five foot length of rubber tubing was drawn slowly around his neck, coming in contact with the skin at the back.

During the solution of a second problem the fear of personal attack was brought into play by having the assistant, who had all the while been concealed noiselessly behind the chair in which the subject was seated, suddenly place his hand, slightly chilled from recent immersion in cold water, about the forehead of the subject.

For the third fear test the subject was seated on the threshold of a door which opened above an eighteen inch drop into an adjacent room. After allowing him to become aware of the distance to the floor behind him, his chair was tilted back at such an angle that he was to fall back into the next room as soon as released. He was then asked to close his eyes, and the assistant noiselessly took a position behind the chair and made ready to catch it at a distance of about one foot from the floor. Immediately after beginning the solution of the problem the subject was allowed to fall almost to the floor; he was then lifted to the original tilted position and held there until he succeeded at his task.

During a fourth problem the disturbing influence was the expectation of receiving an electrical shock of unknown intensity. After professing to him that the test was to be one of ability to endure pain, and asking him if he knew how many volts he could endure, the experimenter had him take in hand two exposed electric wires which seemed to be connected with a wooden box containing four electric lamps, which lighted up every time the experimenter turned on the current by snapping the switch. Prior to taking the exposed wires the subject had seen the experimenter turn on the current twice as if to make sure that the connections were all intact. Upon giving out the problem to the subject the experimenter moved toward the switch and at the end of five seconds turned it on; immediately thereafter he turned it off, and

began to busy himself pretending to rectify an apparent break in the connection of the wiring, such as might satisfactorily explain to the subject why he had felt no shock when the current was first turned on. After ten seconds of such delay the switch was again snapped on, and the same pretence gone through with as many as three times, unless the subject had meantime solved the problem.

Sex Interest. The four stimuli used for this instinct were all of the same sort, for the reason that only one kind of stimulus suggested itself as being both practicable and likely to produce some degree of excitement. Four photographs of well-known nudes,—"La Source" by Greuze, two paintings of Venus by Titian, and a Venus by Giorgione answered the purpose. The subject was asked to perform his multiplication while looking at a nude.

Repulsion. Of the four stimuli used, one was smell, one visual, and two involved a combination of smell and touch. First the subject submitted to a moderately strong whiff of asafoetida; next he multiplied while looking at a picture of human entrails; his third problem was done while holding a human brain over a jar in which the odor of formalin was quite distinct, and the fourth while he immersed his hand in the midst of a number of sheeps' brains in another jar which also contained formalin.

Embarrassment. In order to test the degree to which the subject's mental operations would be retarded by his having to face a crowd, he was given four problems to solve while seated conspicuously in the presence of a class room full of watching students. In most cases the number of onlookers was sixty-five, but for a few men it was necessary to use a group of twenty-three.

After taking an average of the subject's times for the twenty problems, all of which were given with some accompanying distraction, a separate average was made of the times of the anger series, fear series, etc. When the anger time was then compared with the general average time, an anger score was computed in terms of the percentage of increase or decrease over the general average time. When the percentage of increase was great, it was interpreted as meaning that the element of anger, over and above general distraction, was peculiarly effective in retarding that individual's reactions. By comparing the various percentages of the different subjects it was now possible to rank each of the twenty-two subjects with respect to each of the five emotions, rank 1 indicating the

greatest and rank 22 the least amount of disturbance for a given emotion. The table of percentages and ranks follows:

Subject	Anger		Fear		Sex interest		Repulsion		Embarrassment	
	%	Rank	%	Rank	%	Rank	%	Rank	%	Rank
Bo...	80	2.5	2	17	-28	17.5	-34	15.5	-24	12
Br...	-5	12	3	16	37	1	3	7.5	-39	17
Bw..	-29	18	120	1	-34	22	-35	17	27	4.5
Ca...	2	9	11	15	-28	17.5	20	10	-4	10
Cl...	-43	19	23	10.5	-25	16	-81	22	148	1
Cr...	-55	21	23	10.5	9	9	5	5.5	17	6
Do...	4	8	77	3	19	4	-37	18	-35	14
Fe...	31	6	-39	22	14	14	-6	9	X	X
Gr...	29	7	-20	20	-39	19	3	7.5	27	4.5
Ho..	-48	20	56	6	-13	13	-31	14	34	2
Li...	108	1	39	7	-65	21	-24	13	-59	19
Ly...	80	2.5	-7	18	-60	20	-42	20	28	3
Mu..	-4	10.5	30	9	-3	11	-21	11	X	X
Ni...	-21	16	58	5	-9	12	-34	15.5	6	9
Pa...	-6	14	12	14	12	8	5	5.5	15	7
Pe...	-28	17	76	4	-24	14	-39	19	14	8
Qu..	-4	10.5	19	13	14	5.5	14	3	-60	20
Sm..	48	4	22	12	13	7	-55	21	-28	13
St...	-57	22	102	2	4	10	9	4	-57	18
Wh..	-6	14	-25	21	-25	16	66	1	-7	11
Wr..	-6	14	31	8	31	2	-22	12	-36	15.5
Wt..	37	5	-10	19	27	3	-20	10	-36	15.5

As a partial check on the above rankings sixteen of the subjects were asked to rank themselves on a scale of twenty-two places, each judging by what he knew of his own emotional traits and those of his fellows. Sixty-two statements were obtained from the sixteen men. It was found that the average deviation of a subject's estimate of himself from the ranking of the test was 4.5 places on a scale of twenty-two places, which is equivalent to a positive correlation of .37. For fifty-seven of the sixty-two judgments the average deviation from the test ranks was only 3.5 places, or the equivalent of a correlation of .51; and twenty-six of the judgments fell within one place of the corresponding test rank. A further and more complete check, which is to be applied as soon as the data are available, is the correction of the test ranks with an order of ranking based on the consensus of opinion of the whole group, each subject judging every other subject with respect to the five emotional traits.

Conclusions

1. The individual variations in the above test are quite sufficient to make it possible to rank a group of subjects in

respect to the amount of interference created by a given emotion.

2. Individual differences are greatest in respect to the capacity for anger and embarrassment, which show a mean variation of 35 on the scale of percentages used; sex interest and repulsion are more constant from individual to individual, as indicated by mean variations of 27 and 24 respectively. Fear stands midway with a mean variation of 31.

3. Fear caused by far the most powerful disturbances in the thought processes involved. The average fear time was 28 per cent higher than the general average of all the emotion times. Next followed anger with an average of 4.86 per cent more than the general average; embarrassment ranked third with minus 3.5; sex interest fourth with minus 10; and repulsion fifth with minus 16.

4. A comparison of the results for the different emotions suggests that an individual's capacity for fear and for anger are to a certain extent mutually limiting quantities. Their negative correlation of minus .48 is large enough to be considered significant. None of the other correlations were large enough to call for especial comment.

The writer is at present engaged in extending these tests to a larger number of subjects. A beginning was made with 125 individuals, but war conditions have since reduced the number to 44. Two more stimuli have been added to the list for fear and anger, and as a further check on the validity of the method, its results are to be compared with those from a series of memory tests in which the chief point of memorability is to be the emotional interest of the material. Before the method can be entirely satisfactory it will be necessary to arrive at a set of stimuli all of which are accepted at face value by the subject, as were the falling and class-room tests in the above experiments. It is evident also that the variety of stimuli for each emotion should be large enough to cover a considerable number of typical cases.

RETENTION OF SKILL AFTER LAPSE OF PRACTICE: SIMULTANEOUS READING AND WRITING

By JUNE E. DOWNEY and JOHN E. ANDERSON, University of Wyoming

In the twenty-sixth volume of this JOURNAL we reported an experiment upon Automatic Writing, the outcome of which was of interest chiefly because of its bearing upon the possibility of maintaining two simultaneous activities, in this instance reading and writing. As it required considerable effort and practice in order to acquire such measure of skill as we did attain in manipulating the double process, it seemed to us when opportunity offered worth while testing the retention of capacity after a long interval of non-practice. Our last experimental session in any series of the above investigation took place May 14, 1914; our first in 1916 on July 28. In the 1916 investigation the conditions of 1913-14 were duplicated exactly. Both subjects (*D* and *A*) were, however, in better physical condition in 1916 than in 1914; *D* decidedly so. The series of 1916 were carried on solely for purpose of comparison of expertness after the long lapse in practice and were confined to reproduction of only two of the situations dealt with previously, namely writing a memorized verse, (I) while maintaining silent reading, and (II) while reading aloud. In every case the writing was screened from the writer. In 1914, we had found that after much practice we succeeded in bringing the simultaneous processes somewhat closely to the normal speed-limits but the situation was so complicated and required such tension of effort, that we would not have been surprised to find that our hard-won virtuosity had wholly evaporated. This did not prove to be the case.

For directly testing retention of capacity our records, however, leave much to be desired. Our purpose in 1913-1914 being primarily to study the conditions under which automatic writing appears, we varied certain factors in a way that introduces some range of error in the determination of practice effects. For example, the length of the writing interval was governed, in part, by the natural divisions of the story we chanced to be reading. This allowed us to test the effect upon

'distraction of attention' of an increased interest in the story as it approached a climax. In part, we deliberately shortened or lengthened the writing period in order to note the effect of warming-up and of fatigue upon automatic writing. For our present purpose a constant time-interval or a constant number of times of writing the memorized verse between pauses would have been more satisfactory. However, the records make possible some very interesting comparisons.

Before reporting the facts with respect to the double process we shall make a statement concerning the normal spurted speed records of 1913-1914 and 1916, for both reading and writing. The writing records are in terms of the time in seconds required for writing the test verse; the reading-rate in terms of the number of words read per second. In the interval between the practice at speeding, both writing and reading had, of course, continued as normal activities. *A*, as a university graduate student, has presumably practised spurted writing in connection with the taking of lecture notes; *D* had, on the contrary, become interested in a printing movement in writing which might be expected to cause some retardation in speed. So far as reading was concerned, a retardation in *A*'s rate might reasonably have been anticipated from the fact that he had done in the interval considerable critical reading of philosophical prose. *D*, on the other hand, had made some conscious effort to increase her reading rate.

In getting our normal writing-speed for the given verse, perfectly memorized, we had found in 1913-1914 a progressive increase in speed with, as we had thought, an approach to a physical limit in the case of *A*, with whom the investigation was carried out at much greater length than with *D*. The normals for the writing-rate had been obtained both with and without the use of a screen, the records with the screen being consistently more rapid than those without it. *A*'s gain on his initial record, 1913-1914, without the screen, was 5.2 seconds or 12.3 per cent of the initial record. We did not begin taking the normal without the screen until the experiment had run some time so that our records in this respect are inadequate. Nor have we a sufficient number of normals with *D* to make a comparison of much value.

It is, however, possible to compare in *A*'s case the average, the fastest, and the slowest records of the last seven trials in 1913-1914 with the average, the fastest, and the slowest of the first seven trials of 1916. These results are presented in Table I. The last speed records of 1913-1914 were taken for *A* in February, 1914; for *D*, in November, 1913.

TABLE 1

NORMAL SPEED RECORDS. WRITING TEST VERSE

Reagent	With Screen								Without Screen							
	1914				1916				1914				1916			
	Av. last 7 trials	M.V.	Fastest	Slowest	Av., 7 trials	M.V.	Fastest	Slowest	Av., last 7 trials	M.V.	Fastest	Slowest	Av., 7 trials	M.V.	Fastest	Slowest
A	35.7	1.2	33.0	38.0	33.3	1.6	29.8	36.0	36.9	1.1	33.5	40.2	37.5	1.6	34.0	42.0
D					*57.0	2.48	52.5	60.0	†58.94	2.58	54.4	63.2	57.3	3.96	52.0	63.0

* Average of four trials only. † Average of five trials only.

In the case of *A* the average of the first seven trials with the screen is in July 1916, 2.4 seconds or 6.7 per cent more rapid than the last seven in 1914. The fastest speed record for 1916 is 3.2 seconds faster than the speediest for 1914. Without the screen the average for the last seven 1914 is 0.6 seconds faster than the average for 1916, less, however, than the M. V. In both instances, there is a slight increase in the M. V. for 1916.

We interpret this to mean that the effort at increased speeding was checked by the visual perception of the result when the screen was not used; and that, in 1914, *A* had practically reached the limit of writing rapidly consistent with such measure of visual conscience (for penmanship!) as he possessed, advancing from over three to more than four letters per second.

A comparison of the illegibility of the records confirms this conclusion. All of *A*'s spurted speed records are highly illegible but those with the screen more so than those without. A comparison of the first record with the screen, 1916, shows only one second's difference from the last of 1914, a loss less than the mean variation on the last series. The practice effect continues from the first trial on, when the writing is screened from view, although spurting is carried no further in 1916 when writing is visible.

For *D*, who wrote the verse for only one series of experiments in 1913-1914, there are only five records without the screen; the average, 58.9, shows slightly greater rapidity than the average for five in 1916; the M. V. in 1916 is, higher. There are no adequate records for a comparison of the normals without the screen.

We may next consider the normal records for rate of reading in the different years, Table II. These records afford less opportunity for exact comparison than the writing records since they are, in part, dependent upon the text read, upon the stylistic qualities of the author, and upon the variation in interest in the story from point to point. There is perhaps some evidence of a slight increase in *D*'s silent reading-rate, 1916, and a slight decrease in that of *A*. Reasons for this have already been suggested. *A*'s rate of reading aloud would, however, seem slightly increased. The rate of reading aloud is greatly dependent upon degree of effort. In 1914, *A* had learned a means of controlling the voice, etc., that had progressively increased his rate but at a sacrifice of enunciation. It was the impression of the experimenter that in 1916 there was, very evidently, an increased distinctness of enunciation

TABLE II

NORMAL SPERD RECORDS. READING WORDS PER SECOND

Reagent	Silent					Aloud				
	1914			1916		1914			1916	
	First trial, Oct.	Av., last 5 trials, Nov.	Range through whole series	Av., 4-6 trials	Range	First trial	Av., last 7 trials, Apr.-May	Range, Dec.-May	Av., 7 trials	Range
A	8.9	10.4	8.6-12.5	8.2	7.3-9.0	3.33	4.88	3.33-5.15	4.24	3.26-5.67
D	7.4	6.7	5.4-7.6	8.0	6.5-9.2	4.03	5.01	4.01-5.76	(one trial) 3.98	.....

TABLE III

SPEED RECORDS. WRITING TEST-VERSE. DISTRACTION

	Reagent	1913-1914					1916					1914-1916	
		Av., first lap	Av., last lap	Whole No. of trials	Absolute gain	Relative gain, per cent	Av., first lap	Av., last lap	Whole No. of trials	Absolute gain	Relative gain, per cent	Absolute loss, 1914-1916	Relative loss, 1914-1916
Writing Distraction I	*A*	57.58 M.V. 2.16	42.2 M.V. 1.07	116	15.38	26.0	44.1 M.V. 2.05	36.7 M.V. 2.5	35	7.4	16.8	1.9	4.5
	D	89.38 M.V. 13.8	64.27 M.V. 1.48	232	25.11	28.1	71.5 M.V. 5.4	59.7 M.V. 1.9	37	11.8	16.5	7.23	11.2
Writing Distraction II	*A*	71.21 M.V. 15.3	37.96 M.V. 3.01	168	33.25	46.7	62 M.V. 3	37.6 M.V. 1.7	43	24.4	39.4	24.04	63.3
Silent Reading	*A*	7.7	9.3	10	1.6	20.8	6.1	8.01	5	1.91	31.3	3.2	34.4
	D	2.4	4.2	11	1.8	75.0	?	4.86	4	?	?	?	?
Reading Aloud	*A*	2.31	3.62	23	1.31	56.7	2.5	3.52	18	1.02	40.7	1.12	30.9

in conjunction with rapidity, a point of some interest and possibly dependent upon general developmental factors.

Let us turn now to the records when reading and writing are run together, Table III. In our first series of experiments writing was maintained in connection with silent reading (Distraction I). In this instance we are able to make some interesting comparisons, first, between the last lap in 1913-1914 written in pencil, and the first in 1916. The last series of all in 1913 is not taken into consideration inasmuch as this record, contrary to the usual custom, was done in ink. The elimination of this series introduces, however, no error since the records of this day are poorer than those of the preceding session, except in two instances for *D*.

A's first lap (average of 11 trials) in 1916 shows on the face of it a loss of only 1.9 seconds from the last lap of Nov. 1913 (10 trials), a variation which is only slightly more than the mean variation of the last lap of 1913. It must, however, be remembered that *A*'s practice in writing the given verse under distraction was continued with reading aloud after the distraction of silent reading was dropped, so that it would be more significant to compare his final record under distraction (II) for 1914 with the first for 1916. This final record was 37.96 and using this as a basis for comparison we find a loss of 6.14 seconds or 16.1 per cent. As reading aloud was decidedly more distracting for *A* than was silent reading, it seems probable that this loss of more than 6 seconds lies within the actual loss from lapse of practice. *D*'s loss on the final record was 7.23 or 11.2 per cent. Both *A*'s and *D*'s records show in 1916 an increase in the variation of the individual speed records from the average.

Reference to the records shows that by the third day's practice (1916), with silent reading as a distraction, both *A* and *D* had passed beyond the average record of the last lap for 1913-1914 and had established a new speed record. The question arises whether there has been an actual gain in the interval of non-practice in the speed with which learning went on. Our general impression from the introspective ease with which the process was maintained was that this was true. Later, we shall need to reconsider this conclusion.

The experiment involving writing while reading aloud (Distraction II) was carried out in 1914 with *A* alone. Here the loss from the final lap of 1914 to the initial one of 1916 was 24 sec. or 63 per cent. These records are not subject to the error of Distraction I. A comparison of the two records

shows in any case a decidedly greater loss for the situation which for *A* was the more complicated one.

Turning now to the reading records we find that *A* has lost considerably in rate of reading. It is, however, impossible to determine how much this is due to loss of capacity for carrying on the double process since there has also been a decrease in the normal rate of silent reading. It is probably better to confine ourselves to the writing records.

The question raised above then becomes paramount. Since the learning process is one in which a practice effect is continuous, does the rate at which the practice effect goes on increase, decrease, or remain constant after the long interval of rest? There is, possibly, some difference in the case of the two subjects.

In 1916, *D* wrote the verse thirty-seven times under distraction of silent reading. Her initial record was 83 seconds; her final record, 56 seconds; a gain of 27 seconds or 32.5 per cent in the thirty-seven trials. If we take the last thirty-seven records of 1913-1914 (ink records omitted) we find a drop from 70 seconds to 62.4 seconds or a gain of 7.6 seconds, that is, a gain of 10.8 per cent in 37 trials. The rate at which practice went on would seem then to be slightly increased in 1916. Recovery of skill in 1916 took place rapidly so that by the fifth trial *D* is within 0.8 seconds of her final average for 1913. From that point on until the close there was a gain of 13.8 per cent.

If we compare the averages of the laps instead of individual records, we find a confirmation of our conclusion as to an increased rate of improvement. On Nov. 11, 1913, *D*'s average for sixteen trials was 71.52; in July, 1916, the average of thirteen trials (first lap) was 71.50; practically the same. But in the two following laps of approximately the same number of trials there was a fall to 64.27 in 1913 or a gain of 10.1 per cent; in 1916, to 59.7, a gain of 16.5 per cent. There is, then a slight increase in the rate at which practice went on for D. The M. V. is, however, slightly higher in 1916.

A's record, Distraction I, is subject to less obvious interpretation because of the complication of the practice effect with that of Distraction II. He did not, however, approximate his average final record on verse-rapidity with Distraction I, 1913, until his eleventh trial in 1916; nor his final average for verse-rapidity, 1914 (if we take both forms of distraction), until his fifteenth trial. From that point on his relative rate of increase, 1916, was 12.7 per cent, very similar

to *D*'s rate of increase. In 1914, the last twenty trials show no constant increase so that we had concluded that *A* had reached his practice limit.

In 1916, *A* wrote the verse, while reading aloud, forty-three times. The initial record was 60 seconds; the final record, 34.2 seconds, a gain of 25.8 seconds or 43 per cent. If we take the last forty-three records of 1914 (ink records omitted) we find a drop from 49.3 to 36.9, or an increase in rapidity equivalent to 25.1 per cent. Approximation to the final *average* record of 1914 did not occur, until the thirty-ninth trial in 1916; and rapidity increased in the next five trials only 10.5 per cent. The practice effect manifests itself here in a very rapid re-learning. If we take the averages of the laps we find that on Feb. 19, 1914, (44 trials before the close) *A*'s average for six trials was 47.95. In July, 1916, the average of his first four trials was 62. In 1914, the record fell, in forty-four trials, to 37.96—a gain of ten seconds or 20.9 per cent. In 1916 there was a drop in forty-three trials, from 62 seconds to 37.6 seconds, or 39.3 per cent gain. But in large measure the process is one of re-learning.

Unfortunately we do not possess enough data to be able to draw conclusions as to the difference between *D*'s record with distraction I and *A*'s with distraction II. We expect, however, the greater loss to occur for the more complicated process. Possibly, too, the fact that *A* in 1914 approached more nearly the limit of his capacity for carrying the double process than did *D* accounts for some of the difference. Possibly *D*'s improved condition in 1916 is a factor in the case.

Table IV summarizes other data that bear on a comparison of the records of the two reagents. First of all, we note that the relative loss on the normal in the first four trials for 1913 was with Distraction I much higher for *D* than for *A;* in 1916, the relative loss has become practically the same for both.

In this connection we tested *D*'s ability to maintain writing while reading aloud. In 1914, *D* did not try this experiment. Our notes show that in the series in which mental arithmetic was used as a means of distraction, she was unable to carry the double process because of difficulty in handling mental arithmetic. No record occurs concerning writing while reading aloud. If our memory is correct, however, we found the series so long with *A* (twenty-three days of from one hour to two hours' practice each were required to approximate the normal average) that we did not have time to use both subjects. Judging from the ease with which *D* handled the

TABLE IV

SPEED RECORDS. WRITING TEST-VERSE AND NEW VERSE

Reagent	Year	First normal	Average, first four trials	Absolute loss	Relative loss, per cent	First normal	Average, first four trials	Absolute loss	Relative loss, per cent
		Distraction I				Distraction II			
		"Thirty days hath Sept."				"Thirty days hath Sept."			
A	1913-14	39	56.3	17.3	44.4	39	82.8	43.8	112.3
A	1916	34	44.6	10.6	31.2	36	62.0	26.0	72.2
D	1913	59	97.5	38.5	65.3	Not tried.			
D	1916	60	79.5	19.5	32.5	52.5	79.3	26.8	51.0
		"Mary has a little lamb."				"Mary has a little lamb"			
A	1916	23	26.6	3.6	15.7	23.5	43.5	20.0	85.1
D	1916	32	34.0	2.0	6.2	31	50.5	19.0	61.3

given verses in 1916, she would have found this test relatively easier than distraction I. In our notes on taking dictation while reading aloud we noted in 1914 that, relatively, *D* read aloud much more rapidly than she read silently, a fact true also for her normal reading rate.

With Distraction II, *D*'s first attempt in 1916 shows less loss on her normal than does *A*'s first trial in 1916 after 168 trials in 1914. Her relative loss is less than for the average of her first four trials with Distraction I. She had a feeling of having carried over to the new situation the skill acquired in Distraction I; if so, she transferred this capacity very much more effectively than *A* gave any evidence of doing.

In this particular experiment we have, on the one hand, a motor factor involving the unwinding of a series of mechanical movements corresponding to the verse words. On the other hand, we have the maintenance of a double set (attentional). The difference between *A*'s and *D*'s records can be understood if *A*'s acquirement of skill is primarily motor, an unwinding of specific movements, and *D*'s due to a general set of attention, which might more easily function in a modified situation.

In order to obtain data for determining to what degree success in writing the given verse was due to a special motor habit and how far dependent upon general habits of attention we shifted finally to another verse and wrote it while maintaining (I) silent reading and (II) reading aloud. Table IV presents the results.

In *D*'s case, the second verse with silent reading as the distracting process, goes easily from the first. Apparently the whole effect of practise is carried over. *D* reported, however, that the second verse was very much easier to handle than the first, because of its employment of simpler words and a more regular rhythm.

Likewise in *A*'s case the writing of the second verse during silent reading goes easily from the first, indicating that a considerable practice effect is carried over to the new verse. In *A*'s case, however, the relative loss, while only a third of that for the original loss on the test verse in 1913-14, is still twice as great as that of *D* on the new verse in 1916 (which was one-tenth of that on the test verse in 1913). The relative loss of *A* on the new verse is one-half that on the repetition of the test verse in 1916, while that of *D* on the new verse is one-fifth of her loss on the repetition of the test verse in 1916. This confirms the existence of a difference in *A*'s and *D*'s type of reaction to the general situation.

With distraction II, *D*'s relative loss on the new verse is somewhat greater than that on the test-verse, but the latter had the benefit of the practice effect of writing under distraction I. *A*'s record shows some evidence of transfer effect, if we go back to the initial record in 1913; but there is evidence of loss if we consider only the final record. In any case, D handled the situation more easily than A, in spite of his long practice. We conclude that the two subjects give evidence of a significant difference in reaction.

Introspectively *A* reported that in the first fourteen trials 1916 (Distraction I) he went through the whole course of development of 1913-1914. The writing-cue became progressively bigger and bigger. In some respects it seemed to *A* that writing was more automatic than it had been two years before; there was a tendency more frequently to lose his place so that he was bothered by the feeling of not knowing where he was at in the verse.

Lapses were exceedingly frequent in *A*'s 1916 records. In some cases these lapses are simply the cutting of strokes and the dropping out of letters so evidently the result of spurting. The limit toward which *A* was obviously moving was a mere scratching of the pencil, wholly indecipherable, synchronous with the feeling of line-meaning. Before this point was reached in 1916 it was possible to observe some of the old lapses reappearing. Others wholly new put in an appearance, for instance, a confusion in the order of lines so that all are present but in a curiously mixed order. Another change in the appearance of the writing was a shift in the length of the verse lines. *A* broke away from the conventional arrangement in such a fashion as to keep the length of the lines uniform. The intention to spurt operated and induced new methods of increasing speed. These shifts in reaction indicate a relatively greater flexibility in handling the material in 1916 than at the close of 1914 and explain the possibility of *A*'s passing beyond the record of 1914 in which practice had apparently reached its limit. The rest-interval, with its breakup of certain mechanisms, gave freedom for new adaptations. Book expresses it from the other side when he states that the rest-interval operates in causing the dropping out of bad habits.

As was true in 1913-1914, *D*'s lapses in 1916 are in a large measure conspicuous by their absence. Where they appear they are the old lapses of 1913, namely a doubling of the initial stroke on the "y" and "n" and a repeating of "i," with the old curious loss of all motor report for this tiny stroke.

Summary. There is considerable retention of capacity to maintain two processes (reading and writing) after lapse of practice for more than two years, with a rapid re-learning and approximation of one's last record. Subject *D* showed a quicker recovery than Subject *A*. The records of *A* also indicate a much greater loss of capacity for handling the situation that he found the more difficult of the two utilized.

Transfer of the practice effect appeared more evidently for subject *D* than for subject *A*. Since the situation involves both motor and attentional factors, it suggests itself as an excellent one to use in a specific investigation on generalized habits.

A LIMEN COLOR MIXER

By A. P. Weiss, Ohio State University

1. General Description.
2. Differential Color Discs.
3. Use of Mixer for Research.
4. Use of Mixer for Demonstration.
5. Description of Details.

1. General Description

The limen color mixer described in this article was designed to permit fine variations in the percentages of the color components entering into a rotary mixture of colored papers or discs, and to allow accurate control of the duration of the exposure of the colors and the intervals between the exposures. The problem for which the mixer was originally designed was to determine the effect of the adaptation of the eyes to various colors, upon the recognition or discrimination of colors.[1]

To illustrate: Suppose it is desired to determine whether green is more easily recognized as green when the eyes have been first stimulated with red, than when they have not been stimulated by any color other than the normal illumination. To answer this question it is first necessary to determine for the normal unadapted eye what percentage of green it is necessary to add to (say) a black in order that a definite greenish hue may be detected in the black. With a series of differential discs such as those described under 2, it is possible to begin with black only and gradually add small increments of green until the observer is definitely able to detect the green component in the black.

The next step is to stimulate the eye by fixating a large sheet of red paper for a definite period and then determine whether the percentage of green which must be added to the black to make it appear greenish is now greater or less than for the normal condition. As will readily be seen this experiment may be modified in many different ways. Industrially,

[1] The apparatus was used for this purpose by Miss Mary Almack, graduate student in psychology. *Jour. of Exp. Psych.*, Vol. I, No. 5, 1916, p. 426.

it may be used to determine the effect of the various types of illumination on the recognition of colors. The apparatus is relatively simple and quickly manipulated so that unpractised observers may be used.

The limen color mixer may be regarded as a combination of four color mixers, any one of which may be shifted to such a position that only a small area of the rotating disc is exposed. The position of the exposed area can be accurately determined by a micrometer screw arrangement; and from these readings the percentages of the color components may be derived. In general the apparatus may be regarded as a device which permits the control of the following conditions:

1. Many different color combinations are promptly available.
2. Only a small area of the color to be judged is exposed.
3. The percentage composition of the exposed color can be accurately determined.
4. By means of differential discs the increments by which a given color or brightness is changed can be made as small as necessary to meet any condition.
5. The length of time that the color is exposed, and the duration of the interval between successive exposures, can be controlled.
6. The exposure shutters move from the center outward when opening, and in the opposite direction when closing, thus eliminating any tendency toward eye movement.

2. Differential Color Discs

The subliminal steps that are necessary for determining color limens or thresholds are secured by superimposing one color upon another in such geometrical proportions that at various distances from the center of the disc, different proportions of the two colors will occur. One of the simplest geometrical shapes that will permit this is illustrated in figure 1. A cardboard disc 10 inches in diameter is the most satisfactory. Larger discs are likely to be torn during rotation and in smaller discs the radii along which the series of combinations is seen, are too short.

Suppose it is desired to pass from black to green by subliminal steps. If a green disc (fig. 1) has pasted on the face of it two circular black discs b, the part marked a will be green, and the part marked b will be black. When this compound or differential disc is then rotated in a color mixer, the resultant colors will vary from black only at the center, to green only at the periphery. Between the center and the

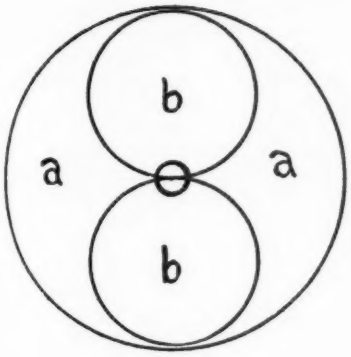

FIG. 1

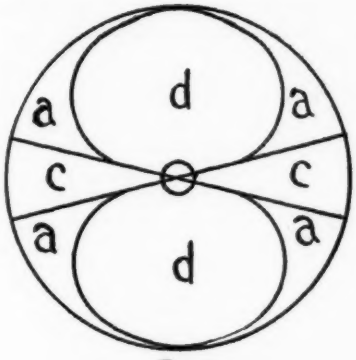

FIG. 2

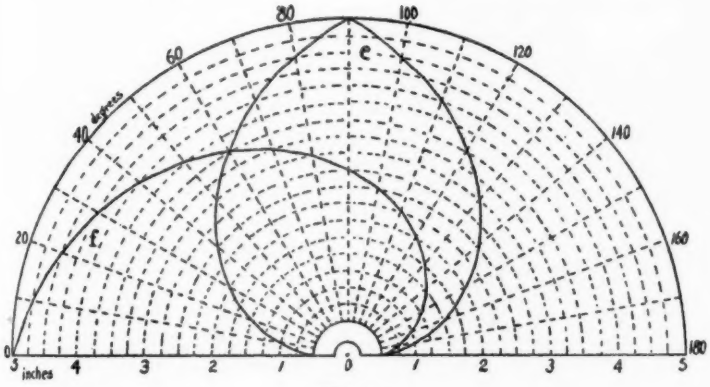

FIG. 3

periphery will be found all possible combinations between black and green. That is, if we consider one of the radii of the disc while it is being rotated, the face of the disc along this radius will not be all of the same color but will be a blended series of blacks and greens beginning with black at the center and becoming more greenish as the periphery is approached, until we have the green of the original color disc.

Referring this combination to the color pyramid we may say that this disc shows all the saturations and brightnesses

of the hue green, between the points black and green on the pyramid. If the circles (b) are a gray of the same brightness as the green, the differential disc will show all the possible saturations of green at the brightness of the original green disc. In this case the series will represent a change in saturation only. By selecting different hues and brightnesses of a and b all the colors between any two points on the pyramid may be shown as a continuous series. By having on hand fifteen or twenty of the various combinations, the demonstration of the color pyramid is much simplified.

Where it is desired to make the steps still more gradual than is indicated in figure 1, a pair of sectors (c) figure 2, of the same color as b may be added. These sectors increase the effect of the b circles by a constant amount, depending on the angular size of the sectors. They may be used also to change the hue of the resultant color. Thus if a is blue, b is red, and c is green, the resultant color on rotation will show combinations of blue, red and green.

In figure 1 the area of the two b circles is equal to the remaining area of the a part of the disc and under these conditions satisfactory series are secured only when the two colors are approximately equal in brightness. Where the differences in brightness between the colors which are to be combined into a continuous series is great, the darker color should cover a larger area than the lighter color. Thus figure 2 represents a combination in which a is light and b dark. Where the difference is very great, as between white and black, it may be necessary to add sectors c of the same color as d. For qualitative work such as class demonstration, b need not be a true circle; but for quantitative work it is simpler, from the geometrical standpoint, to make b true circles, and make whatever changes are necessary by adding the sectors c as was done in the discs shown in the illustrations of the limen color mixer, figures 4 and 5. However, when b is a true circle, the steps from the center outward do not represent equal increments of the color a. The series is geometrical in that the a color is added at first gradually and then more and more rapidly.

To secure equal steps in the addition of the a color with equal steps along the radius, the b color should have the shape of either e or f figure 3. In these shapes equal radial increments are plotted against equal angular increments on polar coördinates. Only one half of the differential disc is shown. The other half is, of course, symmetrical. Where there is difficulty in securing a high speed of rotation it is

best to use the shape e; where the speed is high, the shape f may be used. Both e and f are not, however, to be used on the same disc. If shape f is cut out of colored cardboard or out of another 10 inch disc, it may be used with other circular discs and thus extend its range of usefulness. It is not advisable to try to use shape e independently because it does not fasten so securely as f. These shapes are designed to allow for a thumb nut one inch in diameter. The shapes of e and f are not easily drawn and at best they are only approximations to the true shapes which would be secured if a very large number of points were plotted. Even for quantitative work it was found simpler to use the true a circles of figure 1 and measure the proportions of the a and b colors for any given radius of the disc, with a protractor.

The differential discs described in this section may, of course, be used on any color mixer. They are independent of the limen color mixer.

3. The Limen Color Mixer for Research

When used for research the large sheet iron screen 1 (fig. 4) covers the entire front of the apparatus with the exception of the slot 2 which exposes a shield 4 in which there is a round window 5 that travels from the center to the periphery of whatever disc is in the position 3. The size of window 5 is 5-8 inch in diameter. That is, the only part of the color disc which shows to the observer is the small area which may be seen through the window 5. To illustrate: If a differential disc rotating in position 3, is made up of (a) green and (b) black (fig. 1) the window 5 will expose a small area that will seem to be colored equally all over. If the window is near the center, the color will be less green than when the window is toward the periphery. By means of the screw 6 (fig. 5) the carriage which carries the window 5 and the shutters 19 and 19a, may be shifted anywhere along the radius of the disc, thus securing the various combinations of black and green.

Under ordinary conditions only the disc in the position of the spindle 3 will rotate; any of the other three discs 14, 15, 16, can be shifted quickly to the "running" position by turning the spider 7. By means of this spider the experimenter has four discs or series always available yet not visible to the observer.

The color discs are fastened to the spindles by a thumb nut as in the ordinary color mixers. The position of the window is accurately determined by the screw 6 (fig. 5).

This screw has a pointer on the scale 8 which indicates the number of turns of the screw. At 9 is a circular scale divided into one hundred parts. This is also provided with a pointer. The screw has eight turns per inch and the window 5 is thus moved one eighth of an inch along the radius of the disc for each complete turn of the screw. Since the circular scale 9 is divided into one hundred parts the position of the window may be read to one one-hundreth of an eighth of an inch or .00125 inch (.0318 mm). Assuming that the effective scale is four inches long, this will give a possibility of 3,000 objective steps between the center and the periphery of the disc, each step of which can be secured as often and as accurately as necessary.

This is of course much finer than is necessary for most quantitative work; but in designing the apparatus it was thought best to make the objective steps very small so as to be well within any discriminative limen which would likely be found. Where it is desirable to test the effects of various sources of illumination upon the recognition and discrimination of colors and especially where the changes in the illumination are subliminal, it is necessary to measure small increments in the objective colors very accurately.

The following are some of the research problems for which the apparatus is adapted:

1. Relative influence of hue, brightness and saturation upon each other as determined by discrimination.
2. Effect of various types of illumination (industrial) upon the discrimination or recognition of colors.
3. Effect of selected stimulation (adaptation) upon the discrimination or recognition of colors.
4. Determination of the color composition of after images.
5. Determination of the saturation and brightness limens for color combinations.
6. Effect of the duration of the stimulus and the interval between stimuli upon discrimination and recognition of colors.

4. The Limen Color Mixer for Demonstration

When the color mixer is to be used for demonstrational purposes the screen 1 (fig. 4) and the shield 4 are removed. If it is desired to rotate all four spindles at the same time this is done by passing a round leather belt over the pulleys of all four spindles. This method is used when it is desired to make direct comparisons between different color mixtures, say the different color combinations which will produce gray.

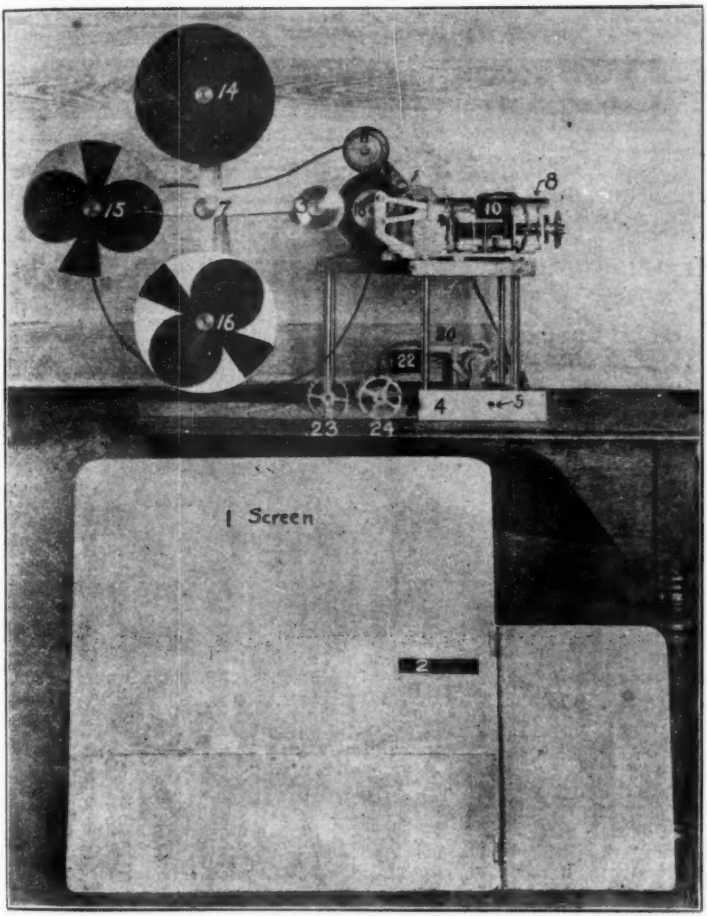

FIG. 4

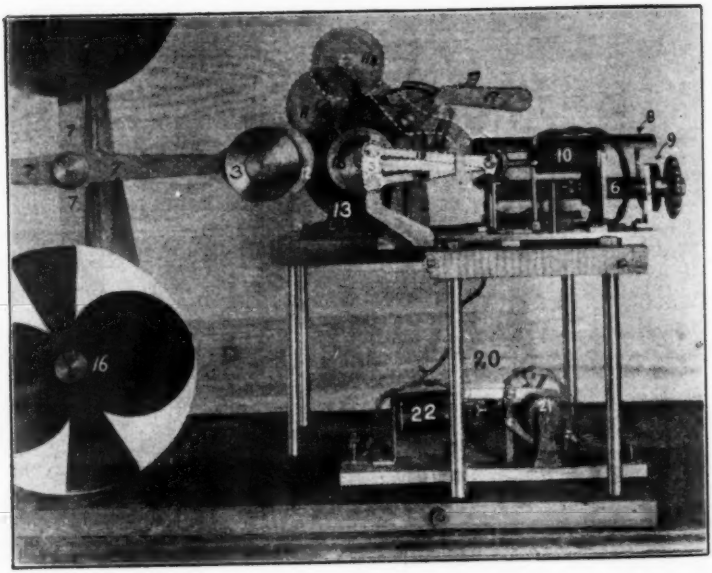

FIG. 5

For class work the limen color mixer lends itself well for the following:

1. Color mixing as it is usually carried out with the ordinary split color discs. Any sized disc up to 10 inches diameter may be used.

2. Continuous series by the aid of the differential discs described in section 2. Where the time is limited about twelve of the differential discs made up of the most important color and brightness combinations are sufficient. For more extensive demonstration, especially where it is desirable to show the manifold interrelations of brightness, saturation and hue combinations, thirty or forty of the differential discs may be profitably used.

3. By using 10 inch discs and having a light gray screen (wall or projection lantern screen) where the class can easily see it, one of the rotating discs may be fixated for a half minute and the after image projected on the screen. Such after images are unusually striking when differential discs are used.

5. Description of Details

The numbers which occur in the following description refer to figures 4 and 5 which are photographic reproductions of the limen color mixer.[2]

Figure 4 shows the apparatus placed on a table with the screen 1 removed and set up against the lower part of the table.

Figure 5 is a reproduction of a phantom photograph of the shutter 19, 19a and idler pulley 11 in both the "on" and "off" positions.

The figures by which the details are numbered refer either to figure 4 or 5.

1. Sheet iron screen, painted neutral gray, which covers the entire apparatus with the exception of window 5.

2. Slot in screen 1 through which window 5 is visible.

4. Tin shield attached to a carriage which is moved back and forth by the screw 6. This shield prevents the observer from seeing the color disc through the slot in screen 1.

5. Window, ⅝ inch diameter through which a cicular area is visible of whatever disc happens to be in the position 3. The distance of this window from the center of the disc is accurately determined by the screw 6. The opening and

[2] The apparatus was constructed by Mr. A. P. Freund, mechanician of the department of physics at the Ohio State University, from sketches furnished by the writer.

closing of this window is brought about by the aluminum shutters 19 and 19a which are operated by the magnet 10 attached to a carriage moved by the screw 6. The shutters open from the center outward and close from the periphery inward.

11. Idler wheel which acts as a friction wheel to turn spindle wheel 12; when in the position 11, the spindle will turn when the motor turns; when in position 11a, it is disengaged and allows the spider 7, which carries the other mixer spindles 14, 15, 16, to be brought into position 3 so that any one of them may be used. The idler 11 is moved by the handle 17 and can be shifted without stopping the motor 13.

13. One-tenth horse-power, alternating current motor, 3,200 revolutions per minute, which drives the color spindles by means of the grooved pulley 18.

20. Timing device modified after Kuhlmann. The ratchet 21 moves one notch whenever the magnet 22 is excited. By a suitable contact device and the proper contact wheels as 23 or 24, the window 5 can be kept open or closed for any period of time. To illustrate: Time wheel 23 has its contact teeth arranged in such a way that when the timer 20 is tripping once per second, the window 5 will give one instantaneous exposure per second. With wheel 24 the window will stay open two seconds and close one second (or the reverse). By selecting the proper wheels any relation of interval and exposure may be secured. The timer 20 is controlled by a pendulum or metronome which makes and breaks the electric current that excites the magnet 22. This pendulum is not shown because it is not an essential part of the apparatus. The pendulum which is used with the apparatus at Ohio State University is a duplex, self-acting electric pendulum designed by the writer. It has been used in many other experiments and has proved so reliable and satisfactory that its construction and method of operation will be the subject of a separate article.

THE FORMATION AND RETENTION OF ASSOCIATIONS AMONG THE INSANE

By CLARK L. HULL

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I. INTRODUCTION

The experiments upon which the present article is based fall into two parts, those performed with insane subjects and those with normal subjects. The experiments with the insane were conducted at the State Hospital for the Insane, at Mendota, Wisconsin,[1] and those with normal subjects in the Psychological Laboratory of the University of Wisconsin.

The problem arose from a consideration of current practice respecting the methods of examining the memory of patients in insane hospitals. The patient, for example, will be told distinctly three or four facts such as the name of a color, a date, and a street address, with the warning that after a certain length of time, say a half hour, he will be asked to recall them. If at the end of that time little or nothing is recalled, and if in addition the patient is unable to recall certain of his more important recent experiences such as took place on his way to the hospital, his memory is considered "poor for recent events." Superficially, of course, such appears to be the case; and a diagnosis based upon such findings by men skilled in their interpretation may possess reliability. Nevertheless, it is at once apparent that under the expression "poor memory for recent events" as here used, are grouped without distinction, two things which are psychologically very

[1] The experiments at Mendota were conducted under the auspices of the Wisconsin Psychiatric Institute, directed by Dr. Wm. D. Lorenz. Dr. Lorenz has kindly verified the case histories and diagnoses included in this report. It is also with pleasure that the writer expresses his thanks to Dr. Frank I. Drake, superintendent of the hospital, and to the medical staff for their active cooperation while the experiments were in progress.

different, and which may quite probably be expected to vary more or less independently of one another. One is the rate of formation of associations, and the other is the degree of retention of these associations, once they are formed. For example in the case under consideration, a patient might fail in the recall either because (a) the name of the color, the date, and the street address made a very slight impression upon his nervous system—perhaps through poor attention, or because (b) though normally registered the impression was very rapidly obliterated, or (c) perhaps because of (a) and (b) both working together.

It was with a view to determining if possible, which if any of the above possibilities were actually taking place in each of three common types of mental defect, and the relative amount of disturbance in each, as indicated by the performance of normals under exactly similar conditions, that the present experiments were chiefly instituted. Incidentally, some interesting evidence was secured concerning fluctuations at the threshold of recall, which will be discussed in some detail in section V of this article.

II. Subjects

In all, nineteen subjects were used in the experiment, nine insane and ten normals. The latter were summer session students at the University of Wisconsin. The insane group consisted of three constitutional inferiors, three dementia praecox, and three paretics; they were very carefully selected from a group of over eighty patients who had previously been experimented on at some length, in an effort to adapt the Binet-Simon tests to the determination of the extent of intellectual degeneration among the insane. They were chosen on a basis of being tractable under experimental conditions, of being relatively clear types of their respective diseases, and of being at about the same intellectual level as shown by the very careful mental tests to which they had all been subjected. The intellectual level chosen was roughly, the ability to pass from thirty-five to forty of the Binet tests (Goddard's revision). Upon trial, however, it was found impossible for paretics of this grade of intelligence to learn the rather difficult material used, so a new group of paretics, of an intellectual ability sufficient to pass from forty-five to fifty tests[2] had to be substituted.

[2] Fifty-one was found to be the median number of tests passed by normal adults of about the same age and station in life. The so-called "wide-range" method of testing was employed.

The following brief case histories of the nine patients were compiled from the clinical records of the hospital, with special reference to memory:

Bur. Male, age 26. Constitutional inferiority with criminal episodes. He attended school for three years but learned little. After his fifteenth year he drank occasionally. He once threatened suicide to scare his father. He had stolen several bicycles and broken into a creamery. When admitted to the hospital he talked freely and relevantly regarding his misdeeds. Later he ran away from the hospital several times. Upon one occasion having been arrested, he set fire to his cell in the jail. His memory appeared normal.

Sch. Male, age 42. Constitutional inferiority with episodes of excitement and depression. He attended district school where he was considered far below the average. Previous to admission he had attacks of depression during which he threatened suicide. In one of them he attacked his wife with a knife. He said that something like a voice told him to do it. During his hospital residence he showed childlike docility though periods of depression continued to appear. His memory was good.

Syg. Female, age 16. Constitutional inferiority with episodes of excitement. She attended school eight years but was below normal in her work. Before admission she was frightened by a drunken attack upon her father and for two weeks showed disturbance and fear. Some months later she became disturbed again and expressed fear of personal injury. During her hospital residence she showed periods of indifference alternating with flighty, mischievous periods.

Don. Male, age 22. Dementia praecox, hebephrenic form. About a year before the experiment he began to visit neighbors and interfere with their work. He became at times incoherent and rambling in his speech. He thought a gang was after him. Upon admission to the hospital he showed no insight into his condition. During his residence he was quiet and orderly.

Jack. Male, age 36. Dementia praecox, simple deteriorating type. Attended agricultural college one year. Upon admission to the hospital he was quiet and orderly. He answered questions irrelevantly and was inclined to mutter. His movements were sluggish and he showed no interest in his surroundings. He seemed to be perfectly contented. His memory was good.

Jaco. Male, age 24. Dementia praecox. He attended common school but was not considered especially bright.

Before admission he thought that there was something queer about him and read the Bible to find out about it. There he found passages referring to him. Just before admission he attempted suicide. Upon admission he was alert and pleasant. He laughed while explaining that he sometimes thinks that his father is Jesus and that he himself is the devil.

Har. Male, age 38. Paresis, cerebral form, mildly expansive type. About two years before the experiment he became very forgetful. He would leave his grip or an auto which he had hired and forget all about them. He thought that he was about to receive enormous profits from some investments. Upon admission his pupils were unequal; they showed sluggish reaction to light and prompt reaction to accommodation. He showed a slight Rhomberg, very active deep reflexes, and tremor of extended fingers, of facial muscles, and of tongue. There was also marked speech defect. Both blood and spinal fluid gave positive Wassermann reactions. He showed mild euphoria and a somewhat faulty memory for recent events.

Sau. Male, age 40. Paresis, cerebral form, demented type. About four years previously he began to drink excessively and to keep loose company shamelessly. Upon admission to the hospital his pupils were unequal and they did not react to light or accommodation. He showed very active deep reflexes, marked tremor of tongue and fingers, slight speech defect, and irregular writing. He gave a positive Wassermann reaction to both blood and spinal fluid. He showed a lack of interest in the examination. Later he had the idea that he was to marry W. J. Bryan's daughter. His memory for recent events seemed to be good.

Ev. Male, age 47. Paresis, tabetic form, expansive type. About two years before the experiment he began to talk about schemes to make large amounts of money. Upon admission his pupils were equal but irregular and of the Argyll-Robertson type. His knee jerks were absent and he showed slight speech defect and tremulous writing. Both blood and spinal fluid gave a positive Wassermann reaction. He showed pronounced euphoria and delusions of grandeur. His memory for recent events was poor.

The patients had become accustomed to examinations through those ordinarily given by the hospital physicians and through presentations at staff meetings. They had all been put through the Binet tests which also gave them some familiarity with the experimenter. He frequently met them in the wards and in general cultivated friendly relations with them.

All appeared to have a friendly attitude toward him; and, with a single exception to be noted later, all co-operated very willingly throughout the experiment and showed a distinct interest in the progress of the learning.

The normal subjects consisted of two men and eight women. They were volunteers from a class in introductory psychology.

III. Procedure

The experiments with the insane were conducted in an ordinary patient's room on one of the quietest wards of the hospital. It was believed that such familiar surroundings would be less disturbing to the patients than a special experimental room.

The experiments with the normals were performed in a small room adjoining the main psychological laboratory, at the University of Wisconsin, the size, lighting, etc., being very similar to those at the hospital. The material to be associated, the apparatus and the general technique were identical for both groups of subjects except in a few cases where rest periods had to be permitted to the insane.

Briefly, the plan of the experiment was to have the various subjects form associations to a certain known degree of perfection. The time consumed served as a measure of the rate at which associations were formed. After a week had elapsed they were tested on these associations. The number of associations correctly recalled, together with the number of promptings required for re-learning served as independent measures of the retention. The material consisted of twelve Chinese characters with twelve nonsense syllables (spoken) one of which was associated with each character. The characters were drawn in ink on cards three-quarters of an inch wide which were placed in holders on a drum. This drum revolved step-wise before a small window.[3] The revolutions were controlled by clockwork within the apparatus which was so adjusted that the exposures were of exactly five seconds duration. A character was thus stationary during practically its entire exposure, being suddenly replaced by the next character in the series at the end of the five-second period. The ticking of the clockwork was slow and very quiet, about like an ordinary clock. The subject sat in a comfortable chair before the apparatus, his eyes about on a level with the exposure window, and his back to the window of the room. The

[3] An imperfect model of this apparatus was demonstrated at the Chicago meeting of the Psychological Association in 1915.

experimenter sat on a high stool at the side of the apparatus, facing the subject.

The names of the characters were taught to the subjects by a prompting method. The experimenter called out their names distinctly at the middle of each exposure as indicated by the ticking of the clockwork. The subject repeated the name each time he was prompted. An exact record of the subject's performance was made upon a special blank as the experiment proceeded, a minus sign being recorded each time the subject required prompting, a plus sign where he was able to respond correctly without being prompted, and in cases where an incorrect response was given, he was corrected and the nature of the error recorded. Thus was secured a very complete record of the process of forming the associations. A typical record by a normal subject (No. 7) is shown in table No. III. The incorrect responses are replaced by minus signs.

The learning was continued without interruption until the subject was able to reproduce consecutively the names of the entire list of twelve characters once without prompting. Then the characters were arranged on the drum in a different order and the learning was continued as before until the subject was able to reproduce the series twice in succession without error. At the beginning, subjects were cautioned not to learn the names of the characters in series and the learning of the second order of characters was introduced to secure this more effectually.

Exactly a week after the completion of the learning, each subject was confronted by the characters again in the second (final) order learned, and he was given two opportunities to name each character, i. e., through two revolutions of the drum. At the third revolution the prompting was resumed as before and continued without interruption until the learning had reached exactly the perfection attained the week before, i. e. two successive perfect reproductions.

During the forgetting period of one week, the insane subjects had no reason to expect that they would be called on to reproduce the material learned. It was necessary, however, to tell the normals to return the following week " for another short experiment " which caused a number of them to wonder if they would be asked to recall what had been learned. But all denied consciously rehearsing any of it to themselves.

IV. Results and Conclusions Respecting Memory

The results of the experiments concerning the formation and retention of associations are shown in Tables I and II, for the insane and the normals respectively. A comparison of these two tables reveals two rather striking features which furnish at least tentative answers to the questions with which we set out.

1. It took, on the average, 102 minutes for the insane to form associations which required on the average only 26 minutes for the normals. Thus the insane as a group show a very great disturbance of the ability to receive impressions, requiring on the average about four times as long as normals. Of the disease groups, the three dementia praecox patients make the three best scores, the three constitutional inferiors average next best, and the three paretics average the worst of all.

TABLE I

Showing for the insane subjects the number of Binet tests passed, the number of minutes required to form the associations, and the amount forgotten after one week.

		Intelligence	Minutes required to form associations			Amount forgotten after one week	
Disease	Subject	No. of Binet tests passed	First order	Second order	Total	No. of characters not recalled	No. of promptings to relearn
Constitutional Inferiors	*Bur.*	37	75	14	89	2.0	0
	Sch.	38	124	46	170	4.5	27
	Syg.	35	51	21	72	5.5	26
Dementia Precox	*Don.*	37.5	36	9	45	7.0	21
	Jack.	40	46	6	52	5.0	19
	vaco.	47.5	29	10	39	1.0	0
Paretics	*Har.*	48	170	30	200	4.0	18
	Sau.	50	45	105	150	2.0	10
	*Ev.**	44	95*	45*	140*	11.3*	258*
Average			72	30	102	3.9	15
M. V			38	22.6	53	1.6	8.9

* The results of subject *Ev.* are not included in the final averages for reasons given on page 426.

2. In marked contrast to the great disturbance in the formation of associations among the insane, we find that once the associations get formed, they are retained practically as well as by normals. In fact the insane patients are able actually

to recall on the average more of the names of the characters at the end of a week than were the normals, averaging 3.9 failures against 4.7 failures by the normals. But when it comes to the labor of relearning, as might be expected from their more rapid learning in the first place, the normals recover their really greater loss in a shorter time, requiring only an average of nine promptings against fifteen for the insane.

The results of the present study accordingly seem to indicate that at least with samples of the three types of mental disease here investigated, the memory disturbance is primarily one of registration rather than of retention. Their memory for recent events is probably normal if the experience succeeds in making a normal impression.

TABLE II

Showing for the normal subjects the number of minutes required to form the associations, and the amount forgotten after one week.

	Minutes required to form association			Amount forgotten after one week	
Subject	First order	Second order	Total	Number of characters not recalled	Total number of promptings to relearn
1. *Bic*.....	17	6	23	4.0	6
2. *Mc*.....	14	8	22	6.5	24
3. *Bir*.....	16	9	25	6.0	12
4. *Fi*.....	12	8	20	4.5	1.5
5. *La*.....	39	7	46	4.5	12
6. *Ha*.....	19	8	27	2.0	3
7. *Ho*.....	19	4	23	3.5	4
8. *Os*.....	17	11	28	4.5	7
9. *Fr*.....	16	9	25	6.5	12
10. *Pi*.....	18	5	23	5.0	14
Average.....	18.6	7.6	26.2	4.7	9.4
M. V.....	4.1	1.6	3.5	1.0	5.25

Two or three details and possible qualifications need to be considered at this point. It will be recalled that in Table I, the results of one subject, (*Ev.*) a paretic, while tabulated with the rest, are not included in the averages. The learning series of this subject was completed successfully, but he strenuously objected to returning a week later to finish the experiment and only went at the emphatic command of the orderly. During the experiment he was sullen, complained of being seriously ill, and obviously made slight effort. He recognized only one of the twelve characters on the test and

consumed 84 minutes in the relearning, requiring over 250 separate promptings in all. His case furnishes a striking contrast to the other abnormals who average only fifteen promptings.

The interpretation of the results in his case are consequently exceedingly doubtful. It is well to remember that this patient had degenerated in intelligence until he was able to pass only 44 of the tests, against a score of 48 and 50 respectively for the other two paretics who showed normal retention. It may also be recalled that a paretic of only a little lower mentality could not learn the material at all. Possibly the retentiveness of paretics becomes disturbed some time after the impressibility has been shattered. It is interesting to note also that this patient had charge of the laundry of his ward and was fairly efficient. On the other hand the paretic *Har.* would very commonly return from an errand to some other part of the building to ask what he had been sent after, having forgotten the errand while on his way to do it. Yet *Har.* gives a smaller record of forgetting than the average normal. The writer inclines to attribute the large score of *Ev.* to possible illness and certain opposition.

The question also arises as to why the insane (with the exception noted above) showed an actually better average score for retention than the normals. In the first place the difference is not great and may have no significance in view of the considerable variation among the insane. The relatively quiet life of the insane might have favored it though all but one of them (*Sau*) performed regular work at the hospital. The long learning periods as such, could scarcely have caused it as it has been repeatedly shown that subjects who take a long time to learn on the whole tend to retain somewhat less than those who learn rapidly.[4]

The most probable explanation seems to lie in the fact that the learning activity produces fatigue which inhibits the power of recall to a certain extent,[5] especially at the end of a protracted learning period. This necessitates a somewhat better learning to produce the required score at the end of a long learning series than at the end of a short one. This may very probably account for the slightly better retention of the insane than of the normals. The experimenter was careful, however, to allow occasional rest periods in the more protracted cases of learning—in two cases rather long one.

[4] D. O. Lyon, "The Relation of Quickness of Learning to Retentiveness", *Archives of Psychology*, No. 34.

[5] E. L. Thorndike, *Educational Psychology*, II., pp. 300ff.

For example, the paretic *Sau*, had a rest period at one time of twenty hours and it is interesting to note that he was able to name correctly more characters after this wait than when he terminated the learning process. During the four minutes preceding the rest he made the following successes: 7, 6, 5, 5; and the first four minutes after resumption: 8, 7, 8, 6. Likewise the other case (*Har.* also a paretic) made an average score of five successes before the rest and of six and one-half successes immediately after resumption.

It is also well known that relearned material is more durable than that only once learned. But this factor must have been slight as the amount forgotten was in each case small, often imperceptible.

V. Fluctuations at the Threshold of Recall

Before the experiment had progressed very far, another marked difference was noticed between the performance of the insane and the normals. This was the greater prevalence among the insane of what may be called "fluctuations at the threshold." What is meant by this may be most easily understood by exhibiting a concrete case (Table III) where the phenomenon appears in a typical form. This is the record of the original learning (first order) of normal subject number seven.

TABLE III

Showing a typical learning record by a normal subject (No. 7).

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
nā 1	−	+	−	−	−	−	−	+	−	−	+	−	+	+	−	−	+	+	+
ōō 2	−	−	−	−	−	−	−	−	−	−	+	−	−	−	+	−	+	+	+
vō 3	−	−	−	−	−	−	−	−	−	+	+	+	+	+	+	+	+	+	+
hui 4	−	−	−	−	−	−	−	−	−	−	−	+	−	−	+	−	+	−	+
ling 5	−	−	−	−	−	+	+	+	+	+	+	+	+	+	+	+	+	+	+
fǐd 6	−	−	−	−	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
tā 7	−	−	−	−	+	−	+	+	+	+	+	+	+	+	+	+	+	+	+
le 8	−	−	−	−	−	−	−	−	−	−	−	−	−	+	+	+	+	+	+
deg 9	−	−	−	−	−	−	−	+	+	+	+	+	+	−	+	+	+	+	+
yer 10	−	+	−	−	−	−	−	−	−	+	+	−	+	+	+	+	−	+	+
nez 11	−	−	−	−	−	+	+	+	−	+	+	+	+	+	+	+	+	+	+
chun 12	−	−	−	+	−	+	+	+	−	+	+	+	+	+	+	+	+	+	+

It will be seen at once from this record that frequently a subject will be prompted several times on an association after which he succeeds on it. But after one or two more trials, success will be followed by failure and this in turn

by success and this again perhaps by failure and so on. By the term fluctuation is understood one or more consecutive successes (plus signs) followed by one or more consecutive failures (minus signs). Thus the record of the formation of the first association shown in Table III (*Na*) has four fluctuations—an unusually large number. The first fluctuation begins with trial 2 and ends with trial 7, the second with trial 8 and ends with trial 10. The third fluctuation begins with trial 11 and ends with trial 12, while the last one begins with trial 13 and ends with trial 16.

Now it will be shown later that in order to make a valid comparison of the records of the normals and the insane in this respect, it will be necessary to know more exactly the nature of the phenomenon under consideration. Superficially, at least, the fluctuation appears to be the result of some sort of wave activity (perhaps related to the attention) which is crossing the threshold. Assuming temporarily that this is the case, we shall proceed to examine in some detail the consequences which might be expected to result. Then we shall examine our experimental results to see how far these *a priori* expectations are justified. And lastly if the correspondence is sufficiently exact to warrant, we shall proceed to the comparison of the records of the abnormals with those of the normals upon this basis.

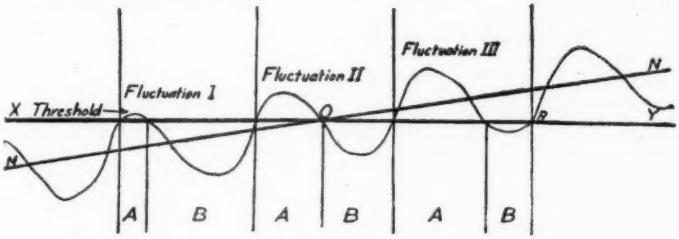

FIG. 1

Accordingly in Figure I let the straight line XY represent the threshold of recall; and let the undulating line MN represent any fluctuating process crossing it at a moderate angle. Then obviously, certain things will be likely to follow:

1. The process would be found to alternate above and below the threshold one or more times.

2. In the first fluctuation of a series of two or more fluctuations, the time above the threshold (A) will be shorter than the time below it (B).

3. In the last fluctuation of a series of two or more fluctuations, the time below the threshold (B) will be shorter than the time above it (A).

4. In the middle fluctuation of a series of three or more fluctuations, the time above the threshold (A) will be approximately equal to the time below it (B).

5. If the waves are regular and uniform throughout, the average duration of all complete fluctuations will be approximately equal in whatever position they occur.

6. If, on the contrary, the size of the waves vary considerably from moment to moment, the shorter waves (with presumably shorter period) will tend to intersect the threshold only in the intermediate fluctuation rather than the first or last, thus making the average total duration of the middle fluctuation of a series of three or more, less than that of either extreme.

7. If the direction of the propagation of the wave process should itself curve towards the horizontal so as to make a more acute angle with the threshold as it rises above the latter, (as is usually assumed to be the case in learning) then the last fluctuation would tend to be of slightly longer duration than the first.

8. The more acute the angle at which the wave process crosses the threshold, the height and period of the wave remaining constant,

A. The greater will be the total number of fluctuations at each crossing.

B. The greater will be the length of time between the first appearance above the threshold to the last disappearance below it, i. e., the greater will be the temporal fluctuation span.

C. The longer will be the time required to mount permanently above the threshold.

9. The taller the waves, their period and the angle at which their direction of propagation crosses the threshold remaining constant,

A. The greater will be the total number of fluctuations at each crossing.

B. The greater will be the temporal fluctuation span.

C. The longer will be the time required to mount permanently above the threshold.[6]

[6] The exact similarity of the results which follow from conditions (8) and (9) will doubtless be noted. This does not mean, however, that the influences of the two factors are indistinguishable from one another. Theoretically at least it is a relatively simple matter to determine for example, how much of the total time consumed in rising per-

We proceed next to see how far our principles developed by *a priori* reasoning are justified by the experimental data. Only two possible cases are open to us. One is to secure the central tendency of the duration of the respective phases of all cases of individual associating processes of two complete fluctuations. The second case is to do the same for all cases of three complete fluctuations. The number of cases of four fluctuations among the normals is too few to possess any reliability, and the extreme variability of the abnormals makes results obtained from them of slight value.

Forty-three cases of double fluctuation were discovered in the records of the ten normal subjects of this experiment, together with the records of twenty other normals who had learned the same material and in the same way but for a different purpose. When added together the total number of successes and failures of the respective phases of each of the two fluctuations are as follows:

Fluctuation I		Fluctuation II	
+	−	+	−
71	88	76	52
159		128	

The totals of fluctuation I clearly accord with principle two, and those of fluctuation II accord completely with principle three. The total time of fluctuation I is distinctly larger than that of fluctuation II, which contradicts principle seven.

We now proceed to the cases of triple fluctuation. In all the thirty odd normal records available for this purpose, only eleven cases of triple fluctuation were found. They are assembled in Table IV and here again the totals will be considered instead of averages.

As before, the relative sizes of the two totals of fluctuation I confirms principle two. Likewise those of the last fluctuation (III) reconfirm principle three. The two totals of fluctuation II while not the same are nearer alike than those of

manently above the threshold was consumed by natural slowness of learning and how much by the fluctuation. In Figure I the entire time consumed in rising permanently above the threshold is XB. If there had been no fluctuations, the threshold would have been crossed for the first and only time at O. Therefore the distance OB is due to the fluctuation and the remainder, XO is due to the natural slowness of learning.

Accordingly, in a given fluctuation record, the part of the apparent learning time consumed by the fluctuation activity ought to be one half of the fluctuation span. If this hypothesis be essentially correct, then this time is really spent in over learning.

either extreme and suggest a confirmation of principle four. The total duration of fluctuation II is less than that of either the first or last fluctuation confirming principle six and tending to reject alternative principle five. Lastly the total duration of fluctuation III is greater than that of fluctuation I thus suggesting confirmation of principle seven.

The coincidences of the experimental results with those of the theoretical analysis while not exact, are nevertheless, very striking. Principles 1, 2, and 3, seem to be amply substantiated; and number 4 also, but with less certainty. Number 6 is confirmed rather than its alternative, number 5, which is what one would expect in a field where practically everything else is subject to variation. The evidence regarding number 7 is conflicting.

Much of the confirmation has necessarily come from the triple fluctuation series which, unfortunately, contains only eleven cases, and naturally its reliability is small. The apparent confirmation may be due to chance, but it is at least interesting to note that if we take separately the totals of

TABLE IV

	Fluctuation I		Fluctuation II		Fluctuation III	
	+	−	+	−	+	−
	1	2	1	1	1	1
	1	2	1	4	1	1
	1	1	2	1	1	2
	1	1	1	1	1	3
	1	2	1	1	1	1
	2	3	1	1	5	1
	1	2	1	1	2	2
	1	2	2	1	2	1
	3	2	1	1	1	1
	1	2	1	2	4	2
	1	1	1	2	3	1
Total	14	20	13	16	22	16
	34		29		38	

either of the two groups of subjects from which they come, all of the significant tendencies appear in each, exactly as when combined. Thus the normals properly of this experiment are:

Fluctuation I		Fluctuation II		Fluctuation III	
+	−	+	−	+	−
7	11	7	9	10	9
18		16		19	

and the subjects from the other experiment:

I		II		III	
+	−	+	−	+	−
7	9	6	7	12	7
16		13		19	

Having disposed of the preliminary theoretical considerations, we may now proceed to a comparison of the relative amounts of fluctuation at the threshold found in the normals and abnormals respectively, according to the principles thus rendered probable. As previously indicated, the insane showed vastly more fluctuations than the normals. But it is obvious from the principles worked out above, notably number 8, that we cannot safely take the gross amounts of fluctuation at face value. On the contrary, if it takes one group of individuals four times as long to cross the threshold as another group, then we must expect that the former group would normally show four times as wide a span of fluctuation, assuming the wave activity to be otherwise identical in the two groups. Clearly then in order to compare the normals with the abnormals in this respect, we must divide the fluctuation span of the latter by 4. If after this the fluctuation span of the insane is still twice as great as that of the normals (as it turns out in fact to be) then we may with considerable certainty conclude (according to principle 9B) that the height (or depth) of the wave among the insane, is approximately twice that of the normals.

TABLE V

Showing the index of the fluctuation span and the index of the number of fluctuations for the insane subjects.

Disease	Subject	Index of fluctuation span	Index of number of fluctuations
Inferiors	*Bur*	4.0	.9
	Sch	2.0	.11
	Syg	5.0	.84
Precox	*Don*	2.plus	.55
	Jack	2.4	.35
	Jaco	3.0	.72
Paretics	*Har*	5.7	.63
	Sau	3.2	.6
	Ev	6.2	.89
Average		3.7	.7
M. V.		1.1	.2

As a matter of fact the technique actually utilized was somewhat more refined than that described above, though based upon the same principle. An index of the fluctuation span was computed for each subject by adding all the fluctuation spans found in each subject's record and dividing the total by the number of minutes required by that subject to complete his first learning. A corresponding index of the *number* of fluctuations was also calculated for each subject per unit time. These are shown for the abnormals and the normals in Tables V and VI respectively.

TABLE VI

Showing the index of the fluctuation span and the index of the number of fluctuations for the normal subjects.

Subject	Index of fluctuation span	Index of number of fluctuations
1. *Bic*	2.6	1.0
2. *Mc*	1.0	.5
3. *Bir*	2.25	.8
4. *Fi*	2.2	.6
5. *La*	1.8	.5
6. *Ha*	.8	.3
7. *Ho*	2.3	.8
8. *Os*	1.9	.5
9. *Fr*	2.25	.6
10. *Pi*	1.6	.4
Average	1.87	.6
M. V.	.46	.16

A comparison of these tables shows that after the fluctuations of the two types of subjects have been reduced to a common basis:

1. The number of fluctuations at each crossing is about the same with the insane as with the normals, the average being respectively .7 and .6. The larger figure with the insane has slight significance in view of the large M. V.

2. The average span of fluctuation (from the first success to the last failure) is almost exactly twice as much for the insane as for the normals being 3.7 for the former and only 1.87 for the latter. This evidently means (principle 9) that the "height" of the individual fluctuations (i. e. the average differences between the crest and the trough of the fluctuation) is approximately twice as great among the insane as among the normals.

VI. Summary

1. The power of forming associations is greatly impaired in constitutional inferiors, demential praecox and paretics.
2. This power is far more seriously impaired in paretics of a given degree of dementia than in the other two types of corresponding degree of dementia.
3. The retentiveness of the three types of insane subjects seems to be entirely undisturbed.
4. The fluctuations which occur at the threshold of recall during the process of forming associations appear on the average to follow very closely the law of an irregularly undulating wave crossing a line, the direction of the propagation of the wave perhaps being that of the conventional curve of learning.
5. Having reduced the respective fluctuation records according to this principle, it is found that the number of fluctuation at each crossing appears to be about the same for the insane as for the normals.
6. It is further found that the fluctuation span of the insane is about twice as great as that of the normals. This indicates that the fluctuation waves of the insane are on the average about twice as profound as those of the normals.

MINOR STUDIES FROM THE PSYCHOLOGICAL LABORATORY OF CORNELL UNIVERSITY

COMMUNICATED BY E. B. TITCHENER and H. P. WELD

XXXV. ON THE PSYCHOLOGICAL RESPONSE TO UNKNOWN PROPER NAMES

By E. M. ALSPACH

This study deals with the first problem proposed by G. English[1] as worthy of additional experimentation; it is a detailed investigation of the reaction of a highly responsive observer to unknown proper names. English had substantiated the results of Kollarits[2] as regards the nature and conditions of the imagery aroused by proper names, but had failed to verify the suggestion of Claparède[3] that there is any community of response to the physiognomy of proper names. Only one of her 8 observers showed any general tendency to be guided in his imagination of persons by the mere sound of the proper name. Further experimentation was necessary, however, before a detailed account of the nature of his response could be made, and this was left for the future.

Fortunately for our study the same observer, the same stimuli, and the unpublished reports of his responses to these stimuli were available. We undertook, therefore, to repeat that part of English's experiment which had to do with the response to nonsense names. We hoped thus to test the stability of the observer's reaction after a fairly long interval of time, to compare the associative factors involved in each group of data, and to obtain fuller characterizations of his meanings and descriptions of the correlated processes.

Method. The stimuli consisted of 50 meaningless words, as follows: Chérin, Póisher, Kílom, Koikert, Vázal, Dáwfisp, Zóquē, Spren, Dáwthō, Rupzóiyat, Blag, Lísrix, Thaspkúwhin, Kírdfaumish, Génras, Thächō, Brob, Zóitū, Kółdak, Múrbix, Chermtgáwkonv, Bóppum, Vúshap, Grib, Watshóiquol, Móikī, Hoxzáuwhuk, Gáwthū, Zēthē, Gówsū, Déznep, Wítaw, Thóbonf, Mávquawpūnt, Stisk, Tówbant, Táquū, Skamth, Quajnūmeth, Būnoy, Drup, Gúklal, Pófmoj, Spux, Jíkzel, Snemth, Thúbtawkarnth, Línrēwex, Gronch, Túpjoz.[4]

The observer sat with eyes closed, and was given a warning signal before the stimulus. The stimuli were presented auditorily; every name was pronounced three times; the experimenter was careful to pronounce it slowly, distinctly, and (as nearly as possible) always in the

[1] G. English, *Amer. J. Psych.*, 17, 1916, 417f.
[2] J. Kollarits, *Arch. de Psychol.*, 14, 1914, 225f.
[3] E. Claparède, *Arch. de Psychol.*, 14, 1914, 310f.
[4] For the method of obtaining these words, see English, *op. cit.*, 432. Rules of pronunciation are as follows: ă as in at, ā as in fate, aw in awning, au as ow in how, ĕ in met, ē in mete, ĭ in in, ī in fine, ŏ in hot, ō in note, oi in oil, ŭ in tub, ū in tube, û as oo in spoon, ch in church, th in thistle, g in get, j in judge, other consonants as usually in English. Unmarked vowels are short.

same manner. The instructions were: "I am going to speak to you the name of a person; the name will be repeated three times; you are to describe that person to me. After the report is completed, I shall call for introspections." Greater emphasis than before was placed upon completeness of the introspective report. In our experiment, *O* was not asked to repeat the word unless he thought there had been incorrect auditory perception of it.[5]

The observer was Professor W. S. Foster, whose long experience in experiments of similar nature contributed not a little to the success of our investigation.

Results. It may be well to state at the outset that we have here a problem in meaning. *O* is given an intrinsically meaningless word and is instructed to put the meaning-of-a-fitting-person upon it. The attitude, therefore, which *O* takes toward the experiment is a meaning and not a process attitude, and the results are, in the first instance, statements of meaning and not descriptions of psychological processes. Since, however, *O* was also asked to report as best he could the nature of his meanings and the correlated processes, we have a second set of results which are, in part at least, psychological. In our presentation of the results we shall, consequently, attempt to treat separately the two sets of data: first, we shall give a brief account of the general attitude of *O* upon his acceptance of the instruction; secondly, we shall discuss the characterizations of the 'persons meant' in English's experiment and in our own; and finally we shall state the nature of *O*'s meanings and their correlated processes.

(1) *O* characterized his attitude as a literary, imaginative mood in which he was set to construct *the* most fitting person. He understood 'person' to signify 'character,' 'mode of action', as much as (or more than) 'physical appearance'. Furthermore, he was disposed to apperceive correctly the sound of the word, and in case of doubt he pronounced the word before beginning the construction.

(2) *O* was able to construct a 'most fitting person' for every one of the 50 stimuli in two different experiments, *i.e.*, in that of English as well as in our own. Fifteen months had elapsed between the completion of English's experiment and the beginning of ours. *O* recalled the general nature of the previous response in only four cases, and reports indefinite recognition of the stimulus-word in six other cases. Since we desire to institute a quantitative as well as a qualitative comparison of the responses in the two groups, we shall, in what follows, disregard these ten cases.

The Associative Factors which Conditioned the 'Fitting Person'. There seem to be five groups of factors which conditioned or suggested the person that best fitted the name. (1) *Nationality.* In about 30% of cases in A and 15% in B,[6] the word was apperceived as sounding like Russian, Chinese, *etc.*, and the person is described (on the basis of suggestion by nationality) as having characteristics typical of the race. Examples are: *Witaw* (A) "Snap of my eyes toward Siberia and immediately a visual image"; *Hoxzauwhuk* (B) "Said the word over and the word 'Eskimo' came with a visual image of an Eskimo dressed in furs"; *Quajnumeth* (A) "As soon as I heard the word the first time it sounded rather familiar to me, then a snap of my eyes towards

[5] In several cases, even the third repetition did not enable *O* later to repeat the word exactly as *E* had said it. Thus: *Vazal* was repeated as *Bazal, Thaspkuwhin* as *Tasquuwhin, Chermtgawkonv* as *Tchirkmgonv.*

[6] We shall, hereafter, designate English's experiment as A, and our own as B.

Mexico, a visual image of an old Indian and the attitude which meant that I knew that he was mild, intelligent, and a solid and substantial person". (2) *Similar name.* In approximately 7.5% of the cases in A and 12.5% in B, *O* apperceived the nonsense-name as related to a similar name, and the person seems to have been described, to a considerable extent, from this similar name. Examples: *Boppum* (A) "Said Bottom at once; with a visual image of Bottom as I've seen him in the play with a feeling for all that goes with him. *Boppum* seems even better than Bottom for the character because the p's are fatter and less educated sounds than the t's. Tried to get a different man, but simply got a less definite, fat and brainless one"; *Dexnep* (A) "As soon as I heard the word, Desmond, the 'Desperate Desmond' of the funny sheets came up verbally and visually and seemed to fit"; *Zoque* (A) "A visual image of X (a real person of the character and appearance described) whose name is Sophie; and I took up the attitude I feel towards her. I did not say or hear the word Sophie, but *Zoque* at once took on the Sophie meaning". (3) *Auditory-verbal associations.* In about 22.5% of A and 17.5% of B *O* seems to have described the person from his auditory-verbal associations. *Skamth* (B) "Repeated the word, which had the meaning of scamp. At once had the visual image of the person, with the attitude I have for a clever rogue, a sort of admiration-disgust"; *Gronch* (A) "A kind of surly, grouchy, piggish, selfish, self-satisfied beggar; has a thick, heavy mustache; grumbles. Thought of *grouch* and *grunts"; Murbix* (A) "A shady character who is afraid of the police; a sneaky fellow; some rather shallow cunning; does not do things on his own initiative, but would make a good tool for a clever criminal. Repeated the word two or three times and word 'murder' and German 'Mörder' came into my head." (4) *Sound of word.* In 25% of A and 35% of B *O* was not conscious, upon hearing the word, of any such sensible associations, but indicates that it was the mere sound of the word from which he described. *Snemth* (B) "Feeling came at once for a character in Dickens; with a visual image; *Sn* is a mean sound; the shortness of the word seems to signify that you have not much respect for him"; *Mavquawpunt* (A) "Repeated the word a number of times and got the feeling for a jouncing, jumpy movement. The name runs off the tongue like an Indian dance; he was a North American Indian, I guess; at least a barbarian"; *Grib* (A) "Had a feeling for him as quickly as I heard the word; felt *Grib* myself, *i.e.,* obstinate, persistent, muscular, common sense; as if I would fight for anything I thought mine; would be surprised if anyone should rebel against my authority"; *Kilom* (B) "A person who often does ludicrous things; gives me a readiness to laugh but I have no notion why. *Ki* rather than *lom* is important in this desire to laugh; the laugh would be a cackling one since the person is ludicrous; an abbreviation and cut-offness about the syllables that suggests this"; *Poisher* (B) "The striking part of the name is *Poish; P* and *Sh* give smooth and slow and *Poish* all together means big". (5) *Combination of factors.* 10% of the cases of A and 10% of B show responses conditioned by more than one of the above. *Linrewex* (A) "A Welshman; the name is Welsh; but *Linrewex* is light and gives me the feeling of ragtime, so he may be a dancer". (Here there is a definite shift from nationality to mere sound of name.) There are several words in which the observer reports that the different parts of the word are contradictory and seem to lead to contradictory responses. *Thaspkuwhin* (B) "There are contradictions in that word: the nationality part of the word taken alone would give a different person than is described. *Thasp* is a miner; a worker in

metals, pounds with a hammer. *Whin* is a frail man with a high-pitched, nasal voice. *Ku* might be a Chinaman"; *Thubtaukarnth* (A) "*Thub* is clumsiness, thick-fingeredness; might say that a man is *thubby*, meaning that he is all thumbs. *Tau* and *karnth* would signify that the person is accurate and definite"; *Gawthu* (A) "There seems to have been a conflict of determinations this time, for the things that come to me are Dawtho (who was a Greek), a French criminal whose name is like Gawthu; or some Indian; all these things seem to work by selection; might be a policeman;" *Rupzoiyat* (B) "The different parts of the word contradict each other to some extent; the personal appearance is mostly *rup;* his nationality is the whole word."

There remain 5% of A and 10% of B, in which *O* was unable to indicate at once any associative factors; but upon letting his associations run (in a sort of 'psychoanalysis'), he found words which suggest that the disposition for a similar name or an auditory-verbal association may have been effective. *Koikert* (A) "A girl, clerk in a department store. It just struck me now that the sound may have reminded me of 'clerk' though I did not have *kert* meaning 'clerk' in mind before;" *Stisk* (B) "A woman, rather tall, bony; angular, rigid, little bit wooden; a very formal person. It seemed to me later that *Stisk* might be Norwegian for 'wood';" *Tupjoz* (A) "A mighty smart jewel-dealer. This is probably because *Tupjoz* is like 'topaz,' but I did not think of this or know it at the time."

It will be observed that the sound of the name was effective in a much larger percentage of cases than former work would lead us to expect. In the hope of showing the correlation between sounds, on the one hand, and personal characteristics, on the other hand, we have constructed the following table. We have divided the reports into two groups, which we call X and Y. X includes, in general, those letters, diphthongs, syllables or entire words which were designated as broad, big, smooth, slow, *etc.* Y includes the opposite class of thin, definite, snappy, clean-cut, *etc.*

GROUP X

Big	Smooth	Slow	Broad, Generous	Soft
bl	p	p	thŭb	thă
g	sh	sh	p	mŏj
chō	răs	t́âquû	găw	pŏf
	sû	blăg	kŏnv	quăj
			ōw	mĕth
			ŏ	
			rŭp	

GROUP Y

Snappy	Active	Clean-cut	Definite	Thin	Sharp	Hard
Koikĕrt	zoiyăt	Koikĕrt	gĕn	fĭsp	Kŏldăk	chō
gĕn	kĭrd	Kŏldăk	Sprĕn	Lĭsrĭx	tŏw	Brŏb
Kŏldăk		tŏw	kărnth	ĭn	Brŏb	thăsp
		Kĭlom		bĭx	Grĭb	Stĭsk
		Lĭnrĕwĕx		rĭn	tŭp	
		kird		whĭn		
				Lĭnrĕwĕx		

From the table it is evident that the consonants ch, th, s, sh, p, b, g, j and the vowels u, ow, and ō are characteristic of Group X, while k, d, t, x, n and i, e, a, oi, ŏ are characteristic of Group Y. We refer the reader, on this point, to L. A. Sherman, *Analytics of Literature*, 1893, 21 ff.; L. P. Smith, *The English Language*, 1912, 102 ff.; W. Wundt, *Die Sprache*, I., 1900, 326 ff.

It is possible that this factor may have been effective in other cases, such as nationality, or auditory-verbal association. The observer reported, in fact, that "other things being equal, a long name was a bit important, a short one a little contemptuous". The following examples are typical: *Quajnumeth* (A) "The long name seemed just right for an old man; *meth* is mildness and *nu* is intelligence"; *Dawtho* (A) "It seemed as if the vowel sounds *aw* and *o*, being broad, generous sort of sounds, go with broad shoulders and good nature"; *Koldak* (B) "The man is quick tempered, vicious; jumps when spoken to. The word is like the sharp, clean-cut ticks of a metronone. *Koltik*, *Galtik*, *Naltik* could be the name and there would be no difference. *Baltik*, *Faltik*, and *Maltik* would be different because not so snappy".

Uniformity of Response in the Two Experiments. How did the observer's response to the nonsense-names in the second experiment compare with those given fifteen months before? The answer to this question should give some indication of the stability of the association between name and 'fitting person'. We have, therefore, compared every one of the 40 responses to the same stimulus-word in the two experiments, on the basis of sex, nationality, size, strength, age, characteristics of movements, temperament, intellect, and social status of the individuals described. These categories are necessarily comprehensive. Thus, 'size' includes both height and weight; 'strength' the person's build and muscular strength. 'Age' was divided into 4 groups: (1) up to 17 years; (2) from 18 to 25 years; (3) from 25 to 45 years; and (4) from 45 on. 'Characteristics of movements' embrace quickness or slowness of movement, clumsiness or deftness, general activity, *etc.* 'Temperament' includes good nature or the lack of it, artistic temperament or the opposite, care or carelessness, *etc.* As 'intellect' we considered general efficiency and common sense as well as actual intelligence. 'Social status' was often determined by occupation. In some of these categories reports are often lacking; and in consequence of the variety of descriptive terms used, interpretation and numerical determination of the correspondences and non-correspondences between the first and second descriptions are often impossible. In the following table, Group I comprises the total number of times any single category, such as age, sex, *etc.*, was given in Experiment A; Group II, the total number of times the same category was given in Experiment B; Group III, the total number of times the category was given, for the same name, in both A and B; and Group IV, the number of times that the response to the same name corresponded. By a simple subtraction, then, the reader can estimate the number of non-correspondences between the two experiments.

A consideration of this table shows two things: (1) *O* tends to give certain categories more often than others in both experiments; *e.g.*, sex, age and size are given much more often than strength and intellect. (2) There are more correspondences than non-correspondences in all categories except nationality, 7 *versus* 10; temperament, 6 *versus* 11; and social status, 3 *versus* 8.

The correspondences, worked out in percents, give an average of 61%, with a mean variation of 18%; and a range from 100% correspondence for strength to 27% for social status. Since the chance corre-

spondence could never be more than 50% (sex), and in most of our cases would be very much less (*e.g.*, social status), it appears probable that a fair degree of significance attaches to every one of our correspondences.

Group I (Given in A)	Group II (Given in B)	Group III (Given in A and B)	Group IV (Corresponds in A and B)
	Sex		
39	39	38	24
	Nationality		
29	23	17	7
	Size		
23	32	16	10
	Strength		
9	12	3	3
	Age		
37	38	37	30
	Movements		
15	15	5	3
	Temperament		
24	29	17	6
	Intellect		
14	14	5	4
	Social Status		
21	20	11	3

(3) *Type of Meaning and Correlated Processes.* The meanings of which *O* was aware and from which the most fitting persons were constructed were vague and indefinite rather than concrete, and our account of them will of necessity be general rather than detailed. The course of the meaningful experience was somewhat as follows. The word had the meaning of a person put upon it by the instructions; when heard, a new meaning (that of the 'most fitting person') was immediately given it by way of the determining factors which we have listed above. The new meaning was of the type which Messer has described as a *Sphärenbewusstsein*,[7] and which *O* in other experiments has described as 'the stimulus-object is this kind of feel'.[8] This 'feel' always pointed in a certain direction; if, *e.g.*, the associative factor was 'na-

[7] A. Messer, Experimentell-psychologische Untersuchungen über das Denken, *Arch. f. d. ges. Psychol.*, 8, 1906, 77-80.

[8] H. P. Weld, Meaning and Process as Distinguished by the Reaction Method. *Studies in Psychology: Titchener Commemorative Volume*, 1917, pp. 181-208.

tionality', then the meaning pointed in the direction of 'a person of that nationality'; if the association was by way of a similar name, then the 'feel' was for a person like him who has the similar name. Furthermore, the 'feel' was often empathic, and the empathy was of three forms. In some cases, the 'feel' was *for* the person, *i.e.*, as *O* would feel if he were in the presence of the person; in others, it was *toward* the person, *i.e.*, as *O* would feel when thinking about the person; in still others it was *of* the person, *i. e.*, as *O* would feel if he were the person. There were times, however, when *O* finds it difficult to state the direction in which the 'feel' points: "Part of the time I can't say myself which the attitude is: toward the sound of the word altogether, toward the person, that which the person himself would take, or a combination of all of these. I think that always it had a part of the first in it; it is an attitude that the sound of the word stirs up. Sometimes I think of the sound of the word merely as sound, sometimes of the length or the kinaesthetic facility (or the opposite) of the word. The position of the face, vocal cords and body is expressive of feeling; sometimes there is the attitude which is the meaning of real words of a sound similar to the one in question."

It is characteristic of *O* that this meaning almost invariably precedes the description of the 'fitting person'; only occasionally does the sound of the name at once touch off a verbal description or an object-meaning (visual image of the most fitting person). When the visual image was present without a definite feeling, there was a tendency to let the associations run and to justify the visual image, and the verbal description seemed then to make for definiteness. In the great majority of cases, however, *O* begins his description when he "knows what sort of person fits", when there is formed a "conscious attitude" representative to some degree both of the stimulus-word and of 'that sort of person'. He says: "The feeling seems to touch off scraps of visual imagery and throw me into a slightly more definite kinaesthetic attitude and so touch off the description". Again, "The whole thing of what to say seems complexly determined; but seems to be summed up in a 'feeling.' The description seems to be a sort of explication of the feeling or of the visual image touched off by the feeling."

On the side of correlated processes, *O*'s conscious attitude was partially analyzed by a description of definite kinaesthesis, organic sensations, *etc.* These processes were usually indicated as the basis of expressive movements when *O* put himself in the place of the person described: *Bunoj* (A) "A saucy, impudent person whose nationality I do not know, but I do know that he stirs me up to antagonism and that I do not like him. I puckered up my face and almost got angry and aggressive"; *Skamth* (B) "Scamp. My attitude is that which I have for a clever rogue; a kind of admiration-disgust; the attitude of pushing out of face and lips and an intense stare"; *Witaw* (B) "A visual image of a dog; tended to set teeth or snarl"; *Blag* (A) "Feel *blaggy* myself; as if to say 'Oh, pooh, that isn't right'"; *Dawfisp* (B) "An unemotional person; chilly; either a man or a woman; feeling was to put arms out and drop head on side, expressive of off-hand, not especially interested attitude"; *Chermtgawkonv* (A) "Gives me definite bodily sets". Sometimes the kinaesthesis was definitely verbal: *Lisrix* (A) "Slips easily off your tongue; no effort; do not have to pay much attention to saying it"; *Zau* (*Hoxzawwhuk*) (A) "Is like 'whoosh', the sound that is made by something going through the air; gave me the notion of 'zouee'"; *Mavquawpunt* (A) "Repeated the word a number of times and got the feeling for a jouncing, jumpy

movement". The specific meaning of 'nationality' or of 'that particular person' was usually carried by eye-kinaesthesis; a movement of the eyes in the direction of the country or of the place associated to the particular person. Visual imagery served in making more concrete the nature of the fitting person.

We conclude that in the case of this 'highly responsive observer' the sound of the word is a determinant of the 'most fitting person' in about 30% of the cases, and that on the whole the correspondence of his responses to the same name is considerably more than chance would allow. The characterization of the fitting person is usually preceded by a meaning of an attitudinal sort which points toward or in the direction of the fitting person, and the characterization itself may be regarded as an explication of this meaning. Kinaesthetic and organic sensations are reported as the correlates of the meaning, and verbal and visual processes carry the more concrete meanings which present themselves in the course of the explication.

XXXVI. The Psychological Basis of Appetite

By E. G. Boring and Amy Luce

The psychological establishment of hunger as a kinaesthetic complex of pressure and pain and its physiological ascription to certain 'hunger-contractions' of the stomach[1] led the early investigators to distinguish hunger from appetite, which was used as a term to denote a desire for food, occurring in the absence of sensory, muscularly conditioned, stomachic hunger.[2] Since the taking of food in the early part of a meal inhibits hunger-contractions and the correlated hunger-sensations, the desire for food which persists to the dessert can not be hunger and has been put forward as the type of appetite. There are various ways in which this desire might be psychologically mediated: the appetite-meaning might consist of an attitude toward food, as would be the case if it consisted merely of a sensorimotor disposition to take and eat food; or it might be carried by specific ideas which involve a food-reference; or it might reduce to a particular pattern of sensations or a particular quality of sensation which, as pattern or quality, is itself appetite.[3] We should have, in the first case, an action-consciousness and, in the second case, an ideational consciousness, of which neither would be psychologically peculiar; appetite would then possess individuality of meaning but not of mental process or pattern. In the third case we should have a truly psychological distinction It is some such sensory account of appetite that Carlson appears to imply when he states on the basis of experimental work, that "the gastric mucosa is

[1] A J. Carlson has summarized this experimental work in *The Control of Hunger in Health and Disease*, 1916; see esp. pp. 16-83.

[2] W B. Cannon and A. L. Washburn, An Explanation of Hunger, *Amer. J. Physiol.*, 29, 1912, 441; Carlson, The Relation between the Contractions of the Empty Stomach and the Sensations of Hunger, *ibid.*, 31, 1913, 185ff.

[3] *Locc. citt.;* E. G. Boring, Processes Referred to the Alimentary and Urinary Tracts: A Qualitative Analysis, *Psychol. Rev.*, 22, 1915, 315f.

endowed with a protopathic sensibility" which constitutes a "gastric component of the sensation of appetite."[4]

Carlson puts forward a specific method for obtaining these gastric sensations of appetite and for distinguishing them from hunger. "Moderately cold water, beer, wine, weak acids (0.5 per cent) or weak alcohol" introduced into the stomach through a stomach-tube "give rise to a characteristic sensation which fuses with, or cannot be distinguished from appetite." "By introducing these substances through the stomach tube at the height of a gastric hunger contraction one actually experiences a *successive contrast of the sensations of hunger and appetite*, as these substances temporarily inhibit the hunger contractions in stimulating the gastric mucosa. . . . From the first it was clear that, when beer, cold or hot water, were introduced into the stomach during a vigorous hunger contraction, the sensation resulting was the exact opposite of that caused by the hunger contraction. In place of an unpleasant, tense sensation, associated with restlessness, the sensation caused by these different stimuli is one of relief. A pleasant tingling sensation is felt in the stomach. One feels perfectly at ease, but the thoughts tend to revert to the dinner table. At first he [Braafladt] was not able to say just what this sensation was like, although it was a familiar one. After paying close attention to the sensation experienced at meals just after a few mouthfuls of food or drink have been swallowed, he became convinced that the two sensations are very much alike if not identical."[5]

Carlson writes as a physiologist and goes no farther than to set the psychological problem. He tells us that appetite is, in part, sensory, but he does not tell us whether the appetite sensation is a unique quality, or a unique spatial, temporal, or intensive pattern of familiar qualities, or simply a distinct meaning which occurs without psychological uniqueness.[6] It was our intention in this study to apply Carlson's method and to obtain a psychological description of the experience which he has called appetite.

Initial Experiments with Carlson's Method. Through one of our stomach-tubes (outside diam., 9 mm.; lumen, 6 mm.) we passed a much smaller tube (outside diam., 4 mm.; lumen, 2 mm.), which projected a few mm. beyond the larger tube and bore on its end a rubber balloon. When this rubber balloon was inflated in the stomach and the external end of the small tube connected to a tambour, we could record stomachic contractions upon a kymograph. The large tube at

[4] Carlson and L. H. Braafladt, On the Sensibility of the Gastric Mucosa, *Amer. J. Physiol.*, 36, 1915, 162ff.; Carlson, *The Control of Hunger, etc.*, 96-118. The use of the term "protopathic" is, in this connection, peculiarly uncritical. Head, who invented the term, had nothing to say of appetite. These authors apparently accept Head's dictum that the internal organs do not mediate "epicritic" sensibility, a position which leads them into incompatibilities; see Boring, *Psychol. Bull*, 14, 1917, 99. And why, furthermore, are we to bestow these newly discovered internal sensations upon "protopathic" rather than upon "deep sensibility"?

[5] Carlson and Braafladt, 162f. The method was demonstrated before the American Biological Societies: Carlson, *Amer. J. Physiol.* 33, 1914, xv.

[6] By the word "sensation" Carlson does not intend to imply psychological simplicity. For example, he uses "hunger sensation" and "hunger sensations" interchangeably (*Control of Hunger, etc.*, 62-71) and appears at the same time to admit the complexity of hunger (p. 26).

its outer end was attached to a device for introducing liquid stimuli [7] under slight pressure; these stimuli could be passed to the stomach inside the large tube and outside the small tube, while the stomachic contractions were being recorded.

Our observers were Dr. E. G. Boring (Bo) and Mr. F. L. Dimmick (D), who had had previous practice in similar experiments,[8] and Miss J. M. Gleason (G).

We had little difficulty with these observers in getting records of typical hunger-contractions with contemporary introspective accounts of the hunger-complex. We were thus assured of the familiarity of our observers with the introspective nature of hunger.

As stimuli we used 5% alcohol, 0.5% HCl, and beef tea. These solutions we introduced in varying amounts (50 cc. to 150 cc.) into the stomach at times when the kymograph tracing indicated strong hunger-contractions. The observers were instructed to give a description of all processes referred to the stomachic region.

This experiment failed of its original intention, because it brought out no organic experience contrasting with hunger or differing markedly from hunger. We did obtain descriptive norms for hunger. When the stimulus was introduced the hunger and the hunger-contractions were sometimes, although not invariably, inhibited. When the hunger was inhibited, there seemed to follow no specific sensory pattern; there was nothing which could be called appetite. All that was left were weak, vague pressures and pains, which passed at times gradually over into a mild hunger. The following reports are typical:

Bo. "Hunger was inhibited suddenly. Then for a moment it was just pressures. Then cold in stomach and throat. Then hunger back again. Then a vague small hard little ache, which seems static for a moment and then begins to fade and fluctuate and spread, and finally turns into a real hunger ache."

D. "The burny pains of hunger left; other pressures stayed. And the gnawing thing went. Later the bright, burny thing came back, after the tube was out, and was more diffuse."

G. "Had heavy pressure [=hunger]. When alcohol entered, the pressure left. Cool in larynx and at place almost to sternum. Then gradually hunger came back very slowly."

On the nature of hunger as a complex of pressure and pain,[9] we may note these reports:

D. "Characeristic thing about hunger is a little bright burny thing at the base of the stomach. It is a pain, although it would not ordinarily be called so. There are other diffuse pressures mixed with this." "I have a painy thing that comes and goes. It comes slowly, welling up, then dies out quickly. That is the central part of hunger. This pain is a funny sort of burny thing."

G. "Hunger is just a pressure, constant, which varies in intensity and is very profuse. And there is a pain which is the same as the pain in extreme pressure. This dull pain comes sometimes for fifteen or thirty seconds."

Bo was familiar with hunger as a complex of kinaesthetic pressure and pain on the basis of other experiments,[10] and did not attempt to describe it separately at this time.

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[7] *Amer. J. Psychol.*, 26, 1915, 8f. and Fig. 1.
[8] *Ibid*, pp. 5-55, 485-494; *Psychol. Rev.*, 22, 1915. 307-330.
[9] Boring, *Psychol. Rev.*, 22, 314f.
[10] *Loc. cit.*

Experimental Meals with a Group of Observers. Our failure to find appetite with Carlson's method led us to look for it under the more normal conditions of the meal.

We began with group meals; for these we added to the three observers already mentioned four others: Mr. H. G. Bishop (Bi.), Mr. C. N. Clark (C), Mr. G. J. Rich (R),—all graduate students,—and Miss A. Luce (L). Every observer was given a note-book in which to write his reports.

In the first experiment these general instructions were given: "Whenever instructed to do so, you are to make in this note-book a report in writing, which shall involve the following points: (1) Are you hungry now? (2) Do you feel any desire for food other than hunger? (3) If you do not have a desire for food in general, do you feel a desire for any particular kind of food? (4) Give a description of any sensory complexes (organic 'feelings') which appear to come from your alimentary canal (mouth, throat, oesophagus, stomach), including any sensations involved in hunger or 'desire for food.'" By these instructions we hoped to bring out appetite, and to get it described in relation to hunger, without directly suggesting Carlson's conclusion to our observers.

The observers were asked under these instructions to write an initial report. Then steaming soup was brought into the room and the odor allowed to diffuse, so that hunger might be accentuated, and a second report was called for. Then the observers ate a few crackers to inhibit the hunger and reported a third time. Then they were told to eat soup and bread "until you have had enough." When they indicated that they had had sufficient soup, crackers and cheese, olives, Nabiscos, and peppermints were set before them, and they were told: "Pick out some article of food which you would like to eat now. Before you eat it, compare your feelings when contemplating eating it with your feeling when contemplating eating more soup, and report on these feelings according to the general instruction."

The results of this experiment indicated that the observers could be trusted to select their own times for reporting, and that they needed to be encouraged to report meanings as well as to describe sensations. Accordingly, for the second experimental meal we used the following instruction: "You are to write in this book successive reports which shall deal with the 'attitudes' and mental processes immediately involved in eating this meal. You should report all *attitudes* or *meanings* that pertain to food-taking (*e.g.*, hunger, desire for food, revulsion, *etc.*) and all *mental processes* (particularly those sensations which are referred to the mouth, throat, oesophagus, and stomach) which underlie these 'attitudes' or meanings. You are to make a report whenever there is a marked change in the 'attitude' or in the sensory complex referred to the alimentary canal. It is suggested that you will probably wish to make *at least* three reports: one before the meal, one after taking a little food, and one toward the end of the meal."

We may note in the first place that our observers had no difficulty in differentiating between hunger and the 'desire for food' or appetite.

Bi. "Hunger has a keen edge of abdominal pressure. Appetite loses the unpleasant accompaniment of hunger. Instead of the pressure and pain of hunger there is a squirming light pressure in the pit of the stomach and increased salivation."

Bo. "Hunger is a dull, slowly fluctuating ache in the stomach region. Appetite is a tactual sensitiveness of my mouth and to a less extent of my oesophagus. Partly mouth watering." "My alimentary canal is 'alive', especially achy (not hunger) near my stomach, and pressury

in my mouth (saliva)." "The big outstanding thing to my 'appetite' is a stomach-ache. It is more lively, of less body, and more easily localized and attended to than is the hunger-ache."

C, although possessing normally a strong appetite, was rarely hungry.

D. "The desire for food is continuous and is therefore something in addition to the sensory thing I call hunger. Hunger is a vague mixture of pressures and a peculiar sort of 'pain' in the region of the stomach." "After eating a few crackers, there was a lull in the hunger sensations, but the desire for food was still present. This desire is a rich complex, and consists largely of mouth and nose components with ever changing visual imagery."

G. "In my stomach a dull extended muscular pressure means hunger; whereas dryness and warmth in my mouth and throat (except when my mouth waters as it does when I get images of food) mean 'desire for food.'"

L. "Appetite is like hunger, but is more mild. It is a very diffuse ache in the region below the sternum." "When I think of eating the mint my mouth has a peculiar tactual sensation and waters somewhat."

R. "Hunger consists of an achy pressure. . . . After taking a few crackers, this pressure-ache tends to disappear and to become spasmodic. Just below it in the body there appears a light tingling pressure. . . . When contemplating olives, I desire to eat them, and I find a faint tingling in the pit of the stomach. The pressures seem to fade out of consciousness while the tingling sensation comes to the front."

We conclude that appetite is not hunger. It may be differentiated from hunger by the nature of certain stomachic sensory components (Bi, Bo, L, R) or by the presence of oral sensory factors (Bi, Bo, D, G, L) or by imagery (D, G). R makes the distinction in terms of stomachic sensations alone; Bi, Bo, and L refer to both the stomachic and oral factors; D and G assign the difference to the oral sensations *plus* their imaginal supplementation.

Already, then, we are gaining a hint of the real nature of appetite. Appetite may involve (*a*) stomachic sensations, (*b*) oral sensations, (*c*) imagery, and, as we shall see later, (*d*) general bodily attitudes or dispositions. Let us take these components up in order.

(*a*) Bi, Bo, C, L, and R report *stomachic* components in appetite.

Besides Bi's report (quoted above) of "a squirming light pressure in the pit of the stomach", he tells at another time of "a heightening of a sinking pressury pain in the region of the stomach", which means appetite. Again: "I get a sort of squirming pressure in the pit of the stomach; it is a light, bright, half-pleasant experience."

Bo gives several reports consistent with those quoted above, which characterized appetite as a 'lively' 'stomach-ache', "of less body, and more easily localized and attended to than is the hunger-ache." For example: "Hunger is gone. There is still an ache in the stomach, but it is almost constant, not so lively, nor so penetrating." And, moreover, appetite "is pleasant, while hunger tends to be unpleasant."

C speaks of a "stomachic sensation of warmth" involved in the desire for food.

We have quoted L's mention of a diffuse stomachic ache, milder than hunger, in appetite. This ache can not be wholly unlike hunger, for it is "a slight contraction-like feeling in the stomach, which fluctuates and is present when I attend to it."

R is explicit in his reference to appetite as "a light, tingling pressure" (see above). This "tingling pressure is localized under the

point of the sternum and further down; it is rather broad and diffuse. I suppose I should simply call it a tingling."

(*b*) Bi, Bo, C, D, G, and L ascribe *oral* components to appetite.

Bi mentions 'mouth-feels' and the flow of saliva. "The feels in the mouth are heightened and the odor of the soup adds to the flow of saliva." "I have a slight flow of saliva as I anticipate the next spoonful."

We have quoted Bo on the "tactual sensitiveness" of mouth and oesophagus and on the salivary pressures in the mouth. Mentions of "mouth sensation including copious salivation" are repeated.

C reports: "At the presence of food, the secretion of saliva increased noticeably. There are sensations of pressure at the base of the tongue." "The appetite remaining seems to be the saliva flow and pressure sensations in the mouth and throat."

D calls the desire for food a "rich complex" which "consists largely of mouth and nose components;" "sniffing and mouth and throat sensations are most prominent."

G describes "dryness and warmth in my mouth and throat, except when my mouth waters. The warmth and dryness in my throat are urgent desire for food, relieved by the moistness." "Mouth waters. Passage seems clear to oesophagus, *i.e.*, relaxed." "With the thought of bread and butter, my mouth and throat seem relaxed and open, *i.e.*, free from strain and pressure."

L writes: "When I think of eating the mint, my mouth has a peculiar tactual sensation and waters somewhat. There is a tactual ache in the back of my throat. When I have a desire for more mint, my mouth waters."

(*c*) D and G, as we have seen, consider *imagery* relevant to appetite.

D reports both "visual imaginal complexes, accompanying" the oral sensations in appetite, and "kinaesthetic images of the puckery and cool feel" which eating olives would give.

G notes that "my mouth waters as I get images of food," and, more specifically, that "it is an image of coolness and smoothness which I get clearly now as I look at bread and butter."

(*d*) Bo and D point out that the desire for food may sometimes be more adequately described as *attitudinal* than as sensory.

Bo writes: "I do not want food violently, but when I think of my alimentary canal I can recognize the impulse for taking food,—a purely motor, determinative thing, that is like the impulse to drink when one is mildly thirsty."[11] "I have the impulse to take food when I think about it in purely kinaesthetic and 'habit' terms."

D says of appetite: "I discovered the dish of olives near by, wanted one, took it, and ate it. The reaching was almost reflex."

Individual Experimental Meals. The group-experiment does not provide the best introspective conditions. Accordingly, we sought to supplement the collective trials by sessions in which single observers dictated their reports to the experimenter. These experiments were made on Bo, D, and G, both when hungry and when replete. When hungry, the observers ate a few crackers to inhibit the hunger contractions. Then, in the presence of olives, or crackers, they were given the following instruction: "Take up an attitude of desiring something to eat. If you succeed in taking this attitude, give me as complete a psychological description of the attitude as you possibly can. Describe any sensations which may be relevant and also characterize the attitude in general terms."

[11] *Ibid.*, 310.

In these trials we find again that Bo reports a *gastric sensory component* of appetite and that D and G do not. It is true that G once mentions a stomachic pressure, but its description resembles hunger and its relevance is not explicitly stated. Bo's gastric appetite is not, however, hunger. It is a bright, lively ache, brighter and livelier than hunger, with a different temporal-spatial pattern from hunger (small, fixed, constantly persisting), and pleasant; "this pleasantness seems to hang right into the quality in just the way that the pleasantness in the ache of stretching does."

The *oral complexes* constitute the most generally recognized basis for the appetite-meaning. The three observers all make much of the sensations which result from increased salivation. They all also mention pressures and aches in the mouth and throat, similar to the sensory basis of thirst,[12] which mean desire for food. G also mentions coolness of the mouth. D and G imply kinaesthetic factors when they say that the movements of the tongue and jaws are free and easy; and G insists further that she feels her throat relaxed. Bo and D report sniffing, as if to inhale the odor of food.

Imagery is assigned a subordinate rôle. All three observers report it, but D now fails to find it relevant to appetite. Bo and G usually consider it as a condition for the increased salivation of appetite rather than as an intrinsic part of the appetite experience. Certain oral images may, however, be relevant. G reports "a taste image,—salt and olfactory;" Bo says, "When I desire the olives, I can image the pressure-pucker which I get with bitter olives." In any case, imagery is subordinate to the oral complex; either it conditions a factor in the oral complex or else it adds imaginally another oral component.

The *kinaesthetic* factors already mentioned represent a deglutitory attitude. The sniffing, the freely moving mouth and tongue, the relaxed throat, all reflect a readiness for food. G speaks of "motor tendencies, which seem widespread in mouth and jaws." Bo and D extended this disposition to the whole body. Appetite was for them at times a reaching-for-food. D, for example, remarks: "The wanting of the cracker is an unconscious tendency to reach for it. The motor side is the first thing that comes." "The big part of appetite is that I can't keep my hand away from the cup. The whole thing is to move and get an olive." "Appetite is mostly a bodily attitude which involves getting and eating, *i.e.*, the muscular side. Part of the time I feel myself reaching and then I see my hand going. That is *Kundgabe*, which means kinaesthetic feels in my arm. And I have kinaesthetic feels or imagery in my jaw and face, twitches which mean chewing, together with movement of the tongue."

Such reports bring us to a difficulty inherent in our problem. Appetite is a meaning; and, though meanings may be recognized and reported, they can not be described. Our observers had no difficulty in recognizing appetite; but they sought to describe it. If there had been some sensory quality which invariably carried the appetite-meaning, they would have doubtless hit upon this sensation as the essential feature in their description. But, Carlson to the contrary, there seems to be no sensory *sine qua non* of appetite. Thus our observers were forced for description to give various available processes which they regarded as relevant to the appetite-meaning. The question of relevance was not always easy for them to decide, and the attempt to make the decision led them often to a report of attitude and away from description. The following protocol of Bo illustrates the variety of reported factors,

[12] *Ibid.*, 310f.

the difficulty of determining their relevance to appetite, and the lapse from description to attitudinal report, in order adequately to account for the appetite-meaning:

"The prominent thing in this appetite is stomachic sensation. There is a more or less static fixed pressure-ache complex, in which the ache is not so dull as it is in hunger, which lacks the intermittence of hunger, and which penetrates into me more. This penetration is a sort of thrust-up, and perhaps arises because my attention tends to shift to my throat, just as is the case with the stomachic temperature sensations which I may localize either in stomach or throat. I don't entirely localize these pressure-aches in my throat, because when I attend to my throat the ache drops out; but the throat-pressure and the stomach-ache do seem to be related because attention shifts back and forth from one to the other so readily. I don't think that hunger leads to the throat in the same way. . . . Then there are also the pressure mouth sensations, involved in copious salivation; both the pressure under my tongue and the feel of the top of it are altered. . . . Both mouth and stomach complexes seem, under critical survey, to be nothing but sensations and scarcely to account for the desire for food. What happens is that, as I look at the crackers and work myself into the situation, sometimes the mouth sensations or more often the stomach sensations get clear, and then all at once I find myself incipiently moving to take a cracker. It seems as if either the stomach or the mouth could mean 'Take a cracker!', and that under the psychological attitude they turn into mere sensations, which are very different things from a desire. . . . As I sit here attending to my report, all at once the stomach thing wells up and gets to be nearly the whole of consciousness; it is immediately supplemented by an attitude of activity which means that I just want badly to pick up a cracker and eat it. If I let my mind dwell on picking up the cracker and eating it, my attention goes back to my mouth, and I find my mouth watering vigorously. The whole experience is analogous to being tickled under psychological conditions. The sensory content of tickle is just sensory content, and the squirming to get away seems perfectly unaccountable and mechanical. But at a commonsense level I feel as if the tickle caused the squirming."

Retrial of Carlson's Method. In our initial experiments with the stomach-tube we failed to find an appetite-sensation. In the experimental meals, however, five observers (Bi, Bo, C, L, and R) reported stomachic components of appetite, whereas only two observers (D and G) did not. It seemed reasonable, then, that we might succeed in isolating a stomachic component if we returned, after the introspective practice of the experimental meals, to the method of the stomach-tube. Since the balloon in the initial experiments had been uncomfortable, we abandoned it in these trials and therewith the record of gastric contraction. We worked with the three observers who had learned to swallow the tube, Bo, D, and G. Warm tomato soup had proved adequate to appetite in the experimental meals; we, therefore, employed it here, in doses of 400 and 200 cc., slowly administered through a funnel. The temperature was such that it gave rise to few thermal sensations. Repletion was produced by the larger dose, but not appreciably by the smaller. The sessions were held when the observers were hungry, and accounts of stomachic sensations, consisting principally of descriptions of hunger, were taken before the tube was introduced. The tube was swallowed to a point 30 cm. from the teeth.

The instruction, given after swallowing the tube, was as follows:

"Take note of the sensations or sensory complexes of stomachic origin which you now have. Then, when you are ready, signal to the experimenter for the stimulus. After the stimulus has been introduced, you are to note again the stomachic sensations or sensory complexes. When you are ready, remove the tube and give as completely as possible a description of the sensory material which you noted both before and after the stimulus."

In the first place, we may note that the introduction of the soup was followed for all observers by the cessation of hunger (inhibition of hunger-contractions, presumably), and that the disappearance of the hunger was followed for Bo and D and probably for G by a short period of 'blankness', during which there appeared to be no sensations referred to the stomach. Bo reports once, as the initial phase of the period, "Nothing;" and in another trial, "After the stimulus the stomachic sensations disappeared entirely. I was completely blank except for the throat sensations from the tube. After all the soup was in, I could still feel no properly stomachic sensation. I am very positive about this." D says: "The first thing I noticed was an absence of sensation as compared with the complex I had before;" "the region now is characterized by its blankness." G notes that "when the soup went in the muscular pain moved all around and then disappeared." We do not find, then, the "successive contrast of the sensations of hunger and appetite," which Carlson has led us to expect.

All observers reported an experience of 'fulness' or repletion, which occurred with the larger dose, and which they described in terms of pressure with sufficient accuracy to distinguish it from the complexes to which we must now turn our attention.

We have seen that under the appetite-situation of the experimental meals Bo tended to report stomachic components, and that D and G practically never did. A similar individual difference holds in these trials. Bo, following the period of 'blankness', finds the live, bright stomachic pressure-aches, which he had formerly designated as a component in appetite, and he is able, although with difficulty, still to attach the appetite-meaning to them. D and G, under these conditions, neither report appetite nor find the bright pressure-aches which somewhat resemble hunger; on the other hand, they are not entirely without stomachic sensations. After the lapse of the period of 'blankness', they find pressure-complexes recurring in the stomach, which indicate that the stimulus may be adequate to some sensation, even if not to the meaning of appetite. The pertinent quotations follow:

Bo: "After the blankness, a pressure-pain, like the hunger-complex, only less intense, not so big, more definitely localized, and of approximately constant intensity. I tried to ask myself whether this was appetite; it did not have the meaning of craving for food that hunger had. It was more a liveness of the stomach region, which means, 'I'd be glad to have more food'. . . . Later this pressure-ache again, on which I could put the appetite meaning voluntarily. . . . Altogether, however, these feelings do not take on gastronomic meanings readily. I could call this 'experimental appetite', meaning that it is not the prominent part of the usual appetite-experience."

D: "Now after the period of blankness I notice a lower pressure, a different pressure from those of hunger and of repletion, which is more superficial. . . . Later the pressures of the first part of the experiment have gone."

G: After the dying out of the hunger pains "I got a diffuse muscular pressure, much less intense than muscular pressure usually is. It seemed undulating and more intense at some times than at others. It

narrowed up. It did not change into pain at all. It persisted as diffuse pressure."

PSYCHOLOGICAL CLASSIFICATION OF THE PROCESSES WHICH CARRY THE MEANING OF APPETITE

		1	2	3	4
		Sensory stomachic complex	Sensory oral complex	Imagery	Kinaesthesis of general bodily attitude
Regular Observers	Bo	Yes	Yes	Sometimes	Yes
	D	Probably not	Yes	Rarely	Yes
	G	Probably not	Yes	Sometimes	Yes
Occasional Observers	Bi	Yes	Yes	.....	.....
	C	Yes	Yes	.....	.....
	L	Yes	Yes	.....	.....
	R	Yes	.....	.....	Possibly

Conclusions. Appetite can be adequately described only as a food-seeking attitude or meaning, a reaching-out-after-food.

A psychological account of appetite attempts to describe the sensory processes correlated with this attitude. In the large they consist in the general kinaesthesis of the orientation of the organism toward food (muscular activity, automatic movement kinaesthetically sensed, *etc.*). The psychological content is as meagre with respect to the total meaning as is the bare content of typically attitudinal experiences like tickle [13] and thirst.[14] (See column 4 of Table.)

The most constant and characteristic feature of appetite is an oral, deglutitory attitude, which involves sniffing, free movement of the mouth and tongue, copious salivation, and relaxation of the throat.[15] The corresponding sensory pattern is a predominantly kinaesthetic complex of pressures and aches, supplemented occasionally by warmth or cold, and reflecting in its specificity the oral attitude. Psychologically it resembles the sensory pattern of thirst,[16] although markedly different in meaning. (See column 2 of Table.)

Imaginal processes are relevant only as they supply oral images or condition the salivary reflex.[17] (See column 3 of Table.)

[13] E. Murray, A Qualitative Analysis of Tickling, *Amer. J. Psychol.*, 19, 1908, 289, esp. 329f.

[14] Boring, *Psychol. Rev.*, 22, 310f.

[15] Possibly also initial movements of deglutition; *cf. ibid.*, 315.

[16] *Ibid.*, 310f.

[17] Cannon and Washburn, therefore, overestimate the importance of imagery in appetite; *loc. cit.*; Cannon, *Bodily Changes in Pain, Hunger, Fear, and Rage*, 1915, 233f.

Food in the stomach may give rise to sensations which do not constitute hunger. These sensations are described as bright, lively, tingling pressures or aches, which are pleasant, and, unlike hunger, static, definitely localized, and easily attended to. Some observers (D, G), however, do not have these sensations; with food in the stomach they report either no sensations at all or vague, indefinite pressures.

The bright, lively, tingling, stomachic complex fuses readily with the oral pattern in carrying the meaning of appetite (Bi, Bo, C, L). It is not, however, essential to the appetite-meaning (Bi, Bo, D, C, G, L), although one observer (R) found that, unsupported, it carried this meaning; and another observer (Bo), that the appetite-meaning could voluntarily, although with difficulty, be added to the isolated stomachic complex. Two observers (D, G) never based appetite upon stomachic sensations. (See column 1 of Table.)

It seems reasonable to suppose that this bright stomachic complex is the same as the "sensibility of the gastric mucosa" described by Carlson. In interpreting this pattern as an essential component of appetite, Carlson and Braafladt presumably put upon it their own individual meanings, which are, apparently, not completely in accord with those of other observers.

Against Carlson we would urge that the stomachic sensations are not always prominent, nor even always present, in appetite; that, when present, they frequently contribute but scantily; and that, when present in isolation, they often cannot mean appetite. It may be that appetite, as meaning, contrasts with hunger; with respect to stomachic sensory pattern, on the contrary, it resembles hunger, though not identical with it. Furthermore, the aspect of appetite does not appear immediately upon the inhibition of hunger by food, but after a short interval.

Finally, we may point out that confusion would often be avoided if the physiologist were to distinguish between the attitude that, as biological meaning, appears unitary, and the psychological sensation which is an observational element. Unitariness of the former may be correlated with complexity in the psychological sphere, and there is no reason to assume that every biologically simple experience has its corresponding single sensation or afferent process.

ON THE COMPUTATION OF THE PROBABLE CORRECTNESS OF DIFFERENCES

By Edwin G. Boring

One of two points of disagreement between Prof. Fernberger[1] and myself [2] is that, while I say that the significance of a difference between two limens or between a test-case and a norm must depend on the probable errors of each of the measures compared, he evidently believes that a significance may be reliably indicated when the probable errors are not available. And of course he is right, for practical instinct is not necessarily based on theoretical conviction. If—to take his instance of Grabfield[3]—we know that a faradic limen above 140 *B*-units has never been found in normal subjects, and that pathological subjects give limens from 120 to over 400 *B*-units (av. = about 200), then the clinician, who finds a threshold of 200, concludes with reasonable certainty that the case is pathological, although he may never know the P.E. of his subject, or of pathological subjects in general, or of the norm. How, then, does the clinician make his diagnosis?

Let us see first what theory requires. A norm is generally based upon many observations upon every one of many individuals. Thus it involves two modes of variability: an inter-individual mode, which is measured by the P.E. of the individual averages, and an intra-individual mode, which is measured by the average of the P.E.'s of the individuals. In theory we must take both into account, as we can by considering a new P.E. of all observations without regard to the individuals, *i.e.*, by taking the P.E. of a sort of 'group-individual.' In the diagnosis of a single subject, we must then consider both these modes of variability: we must find (1) the probability that we have not an instance that is exceptional for the particular individual, and (2) the probability that the individual's average is not merely an unusual case within the normal range of variability of individuals. Actually, we should have to find, by repeating the determinations of the threshold, the individual P.E. of our subject, and then throw that P.E. over against the P.E. which combines both modes of normal variability, before we could determine the probable correctness of the departure of our subject from the norm. If we can not take time to determine our subject's P.E., we may perhaps *assume* that his P.E. is no larger than the average P.E. for normal and pathological subjects, and then use some such measure in determining the P.E. of the difference. If the intra-individual P.E. is known to be fairly constant in all cases, we

[1] S. W. Fernberger, Concerning the Number of Observations Necessary for the Determination of a Limen, *Psychol. Bull.*, 14, 1917, 110.

[2] E. G. Boring, The Number of Observations upon which a Limen May be Based, *Amer. Jour. Psychol.*, 27, 1916, 315.

[3] G. P. Grabfield, Variations in the Sensory Threshold for Faradic Stimulation in Psychopathic Subjects, *Bost. Med. and Surg. Jour.*, 171, 1914, 883; a clinical article, unsatisfactory to the psychophysicist on account of the omission of data.

may perhaps make this assumption with validity; otherwise we must—there is no escape—determine the P.E. of the individual.

The instinctive diagnosis of the clinician means that he knows approximately what degrees of variability he may expect, and that instead of making nice calculations, he simply adopts a rule of refraining from positive diagnosis except when the difference is so great as to be for him unequivocally significant. To state that a faradic threshold greater than 175 *B*-units is "definitely pathological" is to imply a norm, an intra-individual and an inter-individual variability of that norm, and a pathological intra-individual variability. The clinician works implicitly where the psychophysicist works explicitly. Both may be right, but in the doubtful case the odds are with the psychophysicist.

On the other hand, unnecessary labor is always futile, and there are times when the "compromise between time and accuracy," which Fernberger urges, may gain for us more than it loses. If the psychophysicist can determine for the clinician a certain value as a *differentia* (like 175 *B*-units), which has, for known variabilities of the measures involved, a given probable correctness, then he saves the clinician's time. Moreover, there are ways in which he can save his own time.

In the first place, he may utilize that respectable mathematical notion of the negligible quantity. Fernberger laments that "the work of obtaining the probable error of this average threshold would be a very laborious affair." But perhaps it need not be determined; perhaps we may neglect it, that is to say, call it zero. The P.E. of a norm depends on the number of cases involved. If, for example, a norm is based on 50 times as many observations as is a given test-case, and if the variability of norm and test is the same, then, when the P.E. of the norm is taken as zero, the P.E. of the difference is altered by only one *per cent.* Since the norm usually does involve many more observations than the case to be compared with it, its P.E. can frequently be neglected. But one must neglect intelligently.

This principle of the negligible quantity can often be used in another manner. The norm, as we have seen, involves both intra-individual and inter-individual modes of variability. In comparing one individual with another, we work with the intra-individual variability; in comparing a group with another group (pathological cases with normal, perhaps), we take the inter-individual mode; in comparing an individual with a general norm, we use the combined measure of variabilty. If, however, either mode of variability is small with respect to the other, then, in those cases where the combined measure is needed, we may neglect the smaller. Presumably—we are not given the necessary data to make sure—the inter-individual variation in Grabfield's pathological cases is so large that it obscures a relatively small intra-individual variation, which we may therefore disregard.

In the second place, the psychophysicist, when his computation requires a P.E. which he does not know, may sometimes reason by analogy. Suppose that, from known averages and P.E.'s, he has found two or three groups, the averages of which are different, but not significantly different,—a frequent case, since significant differences in a common measure are rare. And suppose that the P.E.'s of these groups are practically the same. Then, if he is given the average of still another group without its P.E., he may assume that it has the same P.E. as the rest and compute the probable correctness of its difference from any one of the rest. If on this assumption he finds a significant difference, it is possible that he has assumed analogy on insufficient grounds; he should suspend judgment. If, on the other hand, he arrives with

his assumed P.E. again at a difference that is not significant, he will probably conclude that this is simply another case of an apparent difference due, not to the heterogeneity of the material, but to normal variability.

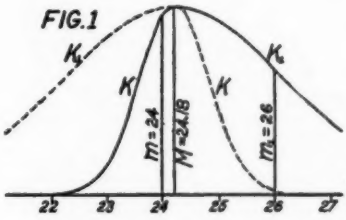
A second point of disagreement between Fernberger and myself concerns the generality of the application of the concept of numerical difference. Comparison, it seems to me, is as broad as science itself; in scientific experiment we change conditions and note the correlated change in a phenomenon, and this change is essentially a difference. Such a difference, when quantitatively expressed with available measures of precision, may conveniently be stated as a probability of difference (probable correctness). But Fernberger says: "We are also interested in the *amount* of that difference. It is true, for example, that we are interested in learning that the savage is more sensitive than the civilized man, but we are also interested in learning that the savage is *twice* as sensitive." And, undoubtedly, we might compute this probability, and also the probability that the savage is one and a half times as sensitive, and one and a quarter times, and so on indefinitely. In any such case we should always have two figures to keep in mind: the amount of the difference and the probability of that amount. If the total fact could be expressed by some single number, such as the probable correctness of the difference, surely an economy of thinking would be effected.

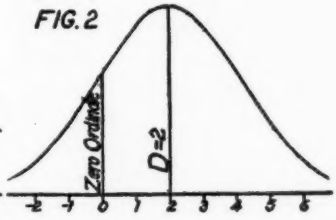
Let us be concrete. Suppose—to take a case of Henri's—that the average reaction-time in a set of 100 experiments is 24 hundredths of a second with a mean variation of 5, and that the average of another set of 25 experiments is 26 with a mean variation of 8. Is the difference between these two averages significant or due to chance? Our conclusion depends upon the six numerical values which we have just given, and we can not think in terms of six different values at once. We may, however, get rid of separate statements of number of cases by writing the P.E.'s of the means, so that we now have but four numbers to keep in mind; $24 \pm .423$ and 26 ± 1.352. We often wish to relate two such pairs of values without knowing how to do it; hence we had better simplify again by computing the difference, which is 2, and its probable error, which is 1.417. Now with only two terms we are getting within thinkable compass; and Fernberger has in them an expression for the amount of the difference and its probability. But we may prefer to simplify still further. Suppose someone should ask us whether this difference of 2 ± 1.417 indicates greater or less homogeneity than a difference, say, of 5 ± 2.8; we probably could not say. As a final simplification we may, therefore, take the ratio of the difference to its P.E.—in this present case, 1.411. Now we have reduced a six-fold statement to a single value. We have not really lost the amount of the difference, because all that we ever had was a difference with a certain probable error upon it, and the probable correctness reflects both the amount of the difference and its P.E. After we have convinced ourselves that a given disparity is significant, we may wish again to take account of its amount; but in so doing we imply a prior interest in its probable correctness. We are, as I have said, "interested in differences *between* limens:" first in the probable correctness and then, sometimes, in the amount.[4]

[4] In general I believe that Fernberger and I are in accord. I did not oppose his recommendations. I sought merely to point out some further implications of his data and to suggest the method of dealing with them.

What I have called the probable correctness of a difference is the probability that a given difference will not be negative, that is to say, that there will be disparity in the same direction as in the observed measures.[5] I have advocated this as the simplest possible measure of disparity and as one that is easily computed.

The question has been raised as to the relation of this "probable correctness" to the "probability that a difference is not due to chance," for which Henri has published a formula.[6] Since the nature of Henri's formula is not easily understood, it may be well to take this opportunity to explain it.





Let us take the case of the reaction times (Henri, p. 159) mentioned above and let us construct a figure in explanation (Fig. 1). We have two means, $m = 24$ and $m_1 = 26$, which we may lay off on our abscissa. We assume tentatively that the two means represent homogeneous data. We now find a weighted average, M, between the two means, which depends on the measure of precision of each mean and the number of cases involved in each; Henri gives the formula (p. 155). $M = 24.18$. If the two means are really homogeneous, then this weighted average is the most probable value of the measure in question and should represent the median of a normal curve of distribution. We can draw such a curve about M if we know its measure of precision. If we regard m as a chance deviate from M, then we may determine the measure of precision with respect to which m, as a mean, varies (p. 156, top); and with this measure of precision we may draw the curve K, of which m becomes an ordinate. Now by means of formula

[5] It can be found, when we know the ratio of the difference to its P.E., from a table of the probability integral; *op. cit.*, 317. In the Cornell Laboratory we have a negative with the requisite equations and a graph of the probability integral, which make the finding of a probable correctness a simple matter. We can furnish blue prints from this negative at a very slight cost.

[6] V. Henri, Quelques applications du calcul des probabilités à la psychologie, *L'année psychol.*, 5, 1898, 153. I am indebted to Dr. L. T. Troland for pointing out the asymmetry of Henri's formula. It is in an attempt to meet certain difficulties that he raised that I add this discussion.

Henri's paper is both obscure and confused by inaccuracies. The following errata should be noted: (1) P. 156, formula (2): for "2_1", read "n_1". (2) P. 159, line 5: for "v", read "v_1". (3) P. 159, line 21: for "3.7", read "3.57". (4) P. 159, last two lines: for "$\frac{1}{11} = 0{,}01$", read "$\frac{189}{171} = 0{,}35$"; and for "0,02", read "0,22". The last error is a miscalculation which almost reverses a conclusion.

(2), (3), or (4) and a table of the probability integral, we find the area included between M and m. Thus, for $m = 24$, $t = .1988$ and the table shows that this area is 22% of the total area to the left of M. (Henri miscalculates this area as 2%!) This area is a measure of the amount that the mean, m, deviates from the theoretical mean, M, which, on the assumption that m and m_1 are homogeneous, is the most probable true value of the measure. But the farther m lies from M the less likely is it that m and m_1 (m_1 by being included in M is the cause of the disparity between m and M) are homogeneous. Thus Henri uses the area between m and M—22% in this case—as a measure of the probability that the difference is due to a determinate cause and not to chance. Conversely the probability that the difference is due to chance is 78%. Here Henri leaves us.

The difference that Henri has been measuring is not, as he implies, the difference between m and m_1; it is the difference between m and M. We can apply the same procedure to m_1 that we did to m. In this case we erect on M the curve K_1, of which the measure of precision is found from the data for m_1. K and K_1 will be different so long as the number of cases in m and m_1 or the measures of precision of m and m_1 are different. The probability that the difference between m_1 and M is due to a determinate cause is 64%. (Henri does not calculate this case.)

Thus it appears that the probability of an operative cause is 22% in the case of m and 64% in the case of m_1, when each is compared with the theoretically most probable mean, M. Can we get a single measure, as Henri does not, for the difference between m and m_1? If m and m_1 were really homogeneous, they would lie on the same curve and we could take the area between them. But, although Henri has considered the two as homogeneous, he has used different measures of precision for each of them, on the assumption (an error, surely) that the proper measure should depend solely on the one variant under consideration, and not upon both of the supposedly homogeneous variants. This mistake is theoretically fatal.[7] Nevertheless, if we want merely a practical measure, we may take the asymmetrical curve made up of K on the left and K_1 on the right, and (considering the areas on either side of M as equal) find the *per cent.* of the total area included between m and m_1. It is 43%. Such a value is not mathematically defensible, but it gives in practice results consistent with the values of "probable correctness," although smaller. It is the only way—so far as I can see—in which Henri's formula can be used in all cases to indicate the significance of a difference.

Fig. 2 shows the "probable correctness" of the difference in this same case of the reaction-times. The actual difference, D, is assumed to vary along a normal distribution curve, for which D is the most probable value, and for which the P.E. of D is the measure of variability. The probable correctness of the difference is the probability that D, in varying, will not assume a negative value, but will always represent a disparity in the same direction. This probable correctness

[7] On the other hand, some such incompatibility is essential to this mode of reasoning. When Henri assumed that m and m_1 were homogeneous, he assumed implicitly that one is just as often greater as less than the other,—the very sort of conclusion that his method aims to give. His formulation of the problem is fundamentally impossible; to think of two means as variants on a single curve is to deny that they have upon the curve fixed places, which would make it possible to determine a distance or an area between them.

is, therefore, the part of the total area under the curve which lies to the right of the zero-ordinate: in this case, 83%.

Since 50% represents pure chance, we may say that a probable correctness of 83% is .66 from pure chance to certain cause. The corresponding value that we got by extending Henri's method was .43. The reason for the discrepancy (.66 and .43) appears in a consideration of the two Figg. In Fig. 1 the difference $m_1—m$ would be reversed if m_1 fell to the left of m or if m fell to the right of m_1. The chance of m_1 falling to the left of m is 39%; the chance of m falling to the right of m_1 is 18%. The chance of the difference being reversed in the one or the other of these ways is thus 57%, that is to say, the area not included between m and m_1. One is tempted to say, then, that the area between m and m_1 (43%) must give the probable correctness of the difference. This, however, is not the case, for m and m_1 ought to be taken as varying simultaneously. There would then be some cases of a reversed difference when both lay between their present values. Since the extension of Henri's formula omits these cases, the probable correctness (probability that the difference is not negative) must be a value greater than 43%. We have found it by the other method to be 66%, provided we take pure chance as zero, as we do in Henri's computations.[8]

It appears, then, that we may extend Henri's method to compute the probability of difference. This extended method and my own method indicate approximately the same thing; but Henri's method involves an unwarrantable mathematical assumption, it fails further to consider the two means as simultaneously variable (thereby giving values too low), and it requires approximately twice as many operations for the determination of a 'probable correctness.' What we want, I take it, is a formula that is both adequate and simple.

[8] We can never, of course, come out with anything more than a probability. To ask whether or not a difference is significant is to talk common sense and mathematical nonsense. Mathematically we can indicate any degree of probable correctness between the limits of complete certainty and pure chance; and differences with various degrees of probable correctness are variously significant. A line between what is significant and what is not can be drawn only by some arbitrary convention. We may place it according to our own personal convictions or with respect to a consensus of scientific usage; or we may take into account considerations of symmetry, as Henri does, and call significant everything that is nearer certainty than pure chance. In this last case probable correctnesses over 75% would be designated as significant. Psychologists would probably put the division at 85 to 95%. The question is one for scientists and not for science, and it can never be permanently settled.

BOOK NOTES

Hindu mind training. By an ANGLO-SAXON MOTHER. With an introduction by S. M. Mitra. New York, Longmans, Green & Co., 1917. 536 p.

The author's interest in this field dates back twenty years when the problem of her eldest son's education began to take practical shape. Since then she has looked into many Western systems, Rousseau, Herbart, Pestalozzi, Montessori, and found none of them satisfactory. Later she came in contact with the Hindu system of education, under the guidance of S. M. Mitra, and this impressed her as on the whole better than any other, and the volume is an attempt to describe this system in a concrete way. The method does not require much of any gradation for it is a method of stories which illustrate virtues or great central themes of human interest. The idea is to select from Hindu literature a story of high illustrative value, tell, and then discuss it. For instance, the first story is that of a commercial genius, the theme being business sagacity. The second is true love or false, the theme being experience as a teacher. Then follow ill-gotten gains, choice or luck, diplomatic success, self-mastery, fortune, love conquers death, health versus wealth, wasted labor, wifely devotion, fatal inadaptability, the use of knowledge, prosperity and adversity, self-observance, psychoanalysis, and finally a long article by Mitra himself.

Man's unconscious conflict; a popular exposition of psychoanalysis. By WILFRID LAY. New York, Dodd, Mead & Co., 1917. 318 p.

Wilfrid Lay, who is said to be a very successful secondary teacher of much experience who had himself found help in psychoanalysis, undertakes here to tell others what it means. To this end he discusses the unknown element in action, the Œdipus myth, the fore-conscious, the unconscious, descriptive unconscious, including symbolism, the censor, pleasure-pain versus reality, reality, regression, etc., the dynamic unconscious including craving reality, where thoughts come from, resistance, conflicts, complexes and phobias, and mental attitude, the individual psyche, dreams, two kinds of thinking (directed and undirected), every-day life, psychotherapy, and educational applications. The book is an interesting manual for the beginner and belongs perhaps in the class with books like White and Bjerre. The writer has a good insight into psychoanalysis and the first part of the book is remarkably lucid and popular, so that it would be almost impossible to miss its teaching. In the latter part he grows far less satisfactory. He betrays a good deal of interest in theories of the relation of the mind to the body, uses certain inapt phrases like "psychic gravitation." Some of his other attempts at modification or addition to the work of the experts we cannot pronounce happy.

The mythology of all races. Edited by LOUIS HERBERT GRAY. *Volume IX, Oceanic.* By ROLAND B. DIXON. 364 p. *Volume X, North American.* By HARTLEY BURR ALEXANDER. 325 p. Boston, Marshall Jones Co., 1916.

The writer of this notice has seen only a few volumes of this series. It is elaborately planned and has an able board of editors; the books

have an ideal, open and clean page, many illustrations, and form in general a good set of references and will prove not only convenient but indispensable for those who specialize in this topic. No single work, of course, can do justice to so vast a theme, and when we remember that Frazer alone has written over twenty volumes, we realize it would take a vast encyclopedia to cover all the ground. What is wanted is a finder that brings things out in true perspective and gives sufficient indication to literature to guide those who wish to specialize.

Our hidden forces; an experimental study of the psychic sciences. By ÉMILE BOIRAC. Trans. and edited with an introduction by W. de Kerlor. New York, Frederick A. Stokes Co., (c. 1917). 302 p.

The author is said to have "given psychical research its passport to travel freely on the road of scientific progress." A problem of mighty import is what has become of the souls of millions of men killed on the battle-field. The author makes a number of experiments in telepathy to show the conductability of psychic force, describes what he calls cryptoidal phenomena, concludes thought is the hidden force, would revise animal magnetism, describes the study of our superliminal powers as the psychology of the future. He is able to provoke sleep at a distance and to produce what he calls transposition of the senses, and describes even the colors of human magnetism. He calls the disconnection of motor nerve force exteriorization or human radiations, and tells us how to study spirits scientifically.

Children's association frequency tables. By HERBERT WOODROW and FRANCES LOWELL. Psychological Monographs, vol. xxii, no. 5, 1916. 110 p.

This is an attempt to make a comparative study of the mental associations of children and adults. It is a study of the psychology of these two groups, made by means of association frequency tables from the responses of a thousand children from nine to twelve, to each of one hundred stimulus words, viz., those of Kent and Rosanoff, and therefore they can be compared with their adult frequency tables, so that conclusions can be drawn from a total of two thousand cases of association. A secondary object of this study was attained by comparing these tables with children to secure data that may serve as a standard in the studies of mental associations of individual children. This method might be used for comparing children of different schools. This study shows that in general children's associations differ enormously from those of adults, and the frequency of various types of association. Adults excel in contrast, superordination, part-whole, noun-abstract attribute, participles and cause-effect. Children excel in verbs, verb-object, noun-adjective, adjective-noun, pronoun, sound simularity, contiguity, whole-part, subordination and word compounding. With only 39% of the stimulus words is the most frequent response the same for both, and with only five words are the three most frequent responses the same. The frequency of the favorite or most frequent response is about the same for both groups. Children give fewer individual responses. They use less number of different words in responses to a given stimulus word. The adults give more of the children's response words than the children do of the adults'.

Standard method of testing juvenile mentality by the Binet-Simon scale with the original questions, pictures, and drawings. By NORBERT J. MELVILLE. Philadelphia, J. B. Lippincott Co. (c. 1917). 142 p.

This is a manual for examiners using the Binet-Simon scale of mental tests. It is especially valuable for its emphasis on a number of highly important points frequently neglected. No man has told us what tests to begin with, or which of two alternative questions should be first employed, or under what condition a test may be repeated, etc. In part two we have such a uniform method of tests worked out in detail.

Two studies in mental tests. I. Variable factors in the Binet tests. II. The diagnostic value of some mental tests. By CARL C. BRIGHAM. (Psychological Monographs, vol. xxiv, no. 1, 1917.) 254 p.

We have here a new and clever discussion of various mental tests, based on Binet, with special reference to their diagnostic values. The author seems very chary about drawing any conclusions, and is dissatisfied with the general disagreement and inconclusiveness of this work.

A scale of performance tests. By RUDOLF PINTNER and DONALD G. PATERSON. New York, D. Appleton & Co., 1917. 218 p.

This book is an attempt to contribute to the few scales already in general use another kind of scale for the purpose of testing intelligence. The work grew directly out of the psychological examination of deaf children, for which purpose ordinary tests were practically useless. Hence these tests do not involve any kind of language response. The tests, fifteen in number, are first described, then their standardization, presentation of the data, the year scale, median mental age, point scale, percentile method, with illustrations at the close.

Mental adjustments. By FREDERICK LYMAN WELLS. New York, D. Appleton & Co., 1917. 331 p.

The author discusses in these eight chapters the following topics: mental adaptation; use and waste in thought and conduct; symbolic association; the continuity of emotion; types of dissociation; mechanisms in dissociated ideas; experimental appproaches; balancing factors.

Mental conflicts and misconduct. By WILLIAM HEALY. Boston, Little, Brown & Co., 1917. 330 p.

The author attempts here to give the living facts that show the great value of understanding the foundation of conduct and misconduct. Conflicts are sometimes accompanied by obsessive imagery, they sometimes cause impelling ideas, some arise from sex experiences or secret knowledge, others result in stealing, running away, they may touch parenthood. The work is very largely a set of case records, and other than this the author makes little attempt to add to our knowledge or to our theory. The reviewer should add that when the author speaks of analysis he does not mean psychoanalysis in anything like the technical sense, nor would it even appear that in discussing conflict he fully realized the broader basis that Freudian analysis has given to this general subject.

The psychology of special abilities and disabilities. By AUGUSTA F. BRONNER. Boston, Little, Brown & Co., 1917. 269 p.

With the increasing educational demands for recognition of the individual rather than of the mass, it is strange that no attempts have yet been made to formulate the problems of specialized abilities and dis-

abilities. Interest in defect has shed much light upon its different types. This author, however, here treats practical aspects, modes of attacking problem-cases, and presents types of special disabilities (a) in the normal, and (b) in the abnormal. Perhaps the best and most suggestive part of the book is the appendix, page 229, where the records and methods of psychological examination are given completely.

An introduction to social psychology. By CHARLES A. ELLWOOD. New York, D. Appleton & Co., 1917. 343 p.

The psychological study of social life designates by far the most important part of modern sociology, and the author here attempts to study the bearings of modern psychological theories upon the problems of social organization and evolution. Some of the more important chapters are: social psychology and its relations and methods; organic and social evolution; human nature and society; the nature of social unity; the nature of social continuity; social change under normal and abnormal conditions; instinct and intelligence in the social life; imitation, suggestion, sympathy and consciousness of kind in the social life; social order, progress, and finally the nature of society.

Wellesley College studies in psychology, no. 2. Edited by ELEANOR A. McC. GAMBLE. Psychological Monographs, vol. xxii, no. 4. October, 1916. 192 p.

This volume contains studies on the following topics: the qualitative relation between complementary and contrast colors; a study of spatial associations in learning and in recall; rate of repetition and tenacity of impression; the relative amounts of fatigue involved in memorizing by slow and by rapid repetition; a note on the use of the method of constants in experiments in intensive smell discrimination.

The adventure of death. By ROBERT W. MACKENNA. New York, G. P. Putnam's Sons, 1917. 197 p.

The purpose of this book is to show that death is not painful and that as a rule the most timid traveler divests himself of all fear when the shadow of the gateway looms over him. This is the conclusion of the author, who is a physician and is also that of his many colleagues with whom he has taught, as well as the available evidence of literature and history. It is especially appropriate in this war-time when death holds its high carnival. The author discusses not only the fear of death, its painlessness and euthanasia, and what it teaches life, but also in final chapters, whether death ends all. This question he answers in the negative if we rightly understand what death means.

A chemical sign of life. By SHIRO TASHIRO. Chicago, University of Chicago Press (c. 1917). 142 p.

This work attempts to apply facts discovered through the study of the physiology of the nerves to living processes generally, and the author thinks that in this mechanism culminates the most characteristic thing in life. He believes he has discovered its chemical accompaniment in nerve fibres. Despite its experimental basis, the work is highly speculative and the critical reader can hardly believe that he has discovered the true connection between irritability and metabolism, clever though his biometric work is.

The biology of twins (mammals). By HORATIO HACKETT NEWMAN. Chicago, University of Chicago Press (c. 1917). 185 p.

This volume brings together for the first time a mass of data on twins in man and other mammals. They are inherently interesting to many people and some light is shed on how twins "happen." The book ought to interest twins as well as biologists for the author discusses not only various kinds of human but animal twins. Perhaps especially interesting is the seventh chapter, on variations and heredity in twins.

The educational bearings of modern psychology. By CHRISTABEL M. MEREDITH. Boston, Houghton Mifflin Co., n. d. 143 p.

The topics are as follows: the nature of instincts; the modification of instincts (purposive action); the modification of instinct (mental growth); the growth of habits and sentiments; environment and suggestion; experiment in education; special studies in connection with memory; and special studies in connection with adolescence.

The spirit of the New Thought. Edited by HORATIO W. DRESSER. New York, T. Y. Crowell Co. (c. 1917). 297 p.

This is a volume of essays and addresses by representative authors in this subject: Henry Wood, Sarah Farmer, the editor, and some dozen others. New Thought seems to have become a kind of sect, in the interests of which these papers are republished. Together we believe that they give a pretty good idea of the modern phase of New Thought.

Cycles of personal belief. By WALDO EMERSON FORBES. Boston, Houghton Mifflin Co., 1917. 150 p.

The work is divided into four parts, namely, illusion, disillusion, reillusion and conclusion. The author discusses in general belief, the world, consciousness, axiomatic propositions, the will, ideas, time, law, unity, selection, and immortality.

How to develop your personality. By CLARE TREE MAJOR. New York, T. Y. Crowell Co. (c. 1916). 121 p.

This is a dramatic work dealing with various human qualities with reference to personality such as breathing, graded exercises, personality of the voice, its quality, what it betrays, poise, emotion, attitude to work, self-confidence, desires and ambitions. The author certainly treats her topics in a breezy way.

New Thought Christianized. By JAMES M. CAMPBELL. New York, T. Y. Crowell Co. (c. 1917). 152 p.

This is almost a kind of manual of twenty-one chapters.

The anti-prohibition manual; a summary of facts and figures dealing with prohibition. 1917. Cincinnati, Nat. Wholesale Liquor Dealers' Association of America. 121 p.

War and criminal anthropology. By ARTHUR MACDONALD. (Repr. from Congressional Record, Feb. 27 and March 15, 1917.) Washington, 1917. 40 p.

Success preparedness. By M. P. OLIVER. New York, T. Y. Crowell Co., (c. 1916) 103 p.